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ABSTRACT

Nutrition is well-recognized as a necessary component of educational programs for physicians. This is to be valued in that of all factors affecting health in the United States, none is more important than nutrition. This can be argued from various perspectives, including health promotion, disease prevention, and therapeutic management. In all cases, serious consideration of nutrition related issues in the practice is seen to be one means to achieve cost-effective medical care. These modules were developed to provide more practical knowledge for primary care physicians in recognizing nutrition-related problems associated with hospital and home care. Application of the material in this module will assist the physician in planning for the hospital stay, shortening the stay, and improving whole health care outcomes. Included are learning goals and objectives, a self-check of achievement with regard to goals, resources for the physician and patient, and references. Appendices include calculation formulas for body composition and weight, procedures for measuring arm muscle circumference, charts of urinary creatinine and ideal weight for height, protein status evaluation criteria, an anergic metabolic profile chart, a nutrition guide, recommended daily dietary allowances, guidelines for criteria of nutritional status, a chart of the composition of oral and enteral supplements, and a logic tree for the use of feeding modules in nutritional support. (CW)

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3. Nutrient and Drug Interactions
4. Normal Diet: Age of Dependency
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23. **Vitamins and Trace Minerals**
24. **Behaviorial and Neurological Disorders**
25. **Preventing Hospital and Home Malnutrition**
26. **Questions About Common Ailments**

Faculty Guide (includes comprehensive index for Modules 1-26)

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Introduction

Quality of nutritional care during hospitalization often suffers because of a variety of factors, including incorrect diagnosis of nutritional needs and inadequate nutritional support. With the implementation of new government reimbursement policies and Diagnosis Related Groups (DRGs), it is imperative that the quality of a patient's hospital treatment be maximized and the length of stay be minimized. Preparation of the patient for care at home is crucial. Topics presented in this module to assist you in maximizing care and minimizing stay by preventing malnutrition include:

1. malnutrition in the hospitalized patient;
2. diagnostic criteria for identifying malnutrition;
3. specific criteria for the identification of potential nutrition problems;
4. strategies to improve nutritional care in the hospital; and
5. specific recommendations on how to maximize an appropriate nutrition care plan for patients at home.

Goal

The goal of this module is to assist the primary care physician in recognizing nutrition-related problems associated with hospital and home care. Application of the material in this module will assist the physician in planning for the hospital stay, shortening the stay, and improving home and health care outcomes.

Objectives

Upon completion of this module, you will be able to:

1. *Value the application of sound nutrition planning as a key element in maximizing the quality of hospital and home care.*
2. *Identify the relationship between malnutrition and the outcome of medical care.*
3. *Identify criteria that can be used in preventing hospital and home malnutrition.*
4. *Determine methods for maximizing nutritional aspects of home health care, including the use of community resources available to the homecoming patient.*

Malnutrition in the Hospitalized Patient

In his classic 1974 article, "Skeleton in the Hospital Closet," Butterworth[1] exposed the problem of iatrogenic malnutrition. Since that time, the issue of malnutrition in the hospitalized patient has gained the attention of the medical community.

What are some diagnoses and associated problems that are likely to precipitate malnutrition?

Clinically significant protein-calorie malnutrition has been estimated to occur in 15% or more of patients hospitalized in acute care settings.[2] Nearly 50% of selected surgical populations have clinical evidence of anemia, vitamin deficiencies, weight loss, reduced arm muscle circumference (muscle mass), and depressed plasma proteins.[3,4] Such percentages lead to speculation as to what are the predisposing factors.

It is possible to categorize predisposing factors for malnutrition into four general areas:

1. **Malingestion of adequate foods.** Examples of these patients include those with dementia, strokes, central nervous system involvement (para- and quadraplegics), no teeth or ill-fitting dentures, oral or esophageal obstruction, as well as patients with anorexia which may be (1) self-imposed, (2) due to old age, or (3) due to systemic diseases and their treatments, such as for cancer, or pulmonary, renal, or cardiovascular disease.
2. **Maldigestion of foods.** Examples of these patients include those with pancreatic or biliary disease, ulcer disease, and disaccharidase deficiencies.
3. **Malabsorption or increased requirements of nutrients.** Examples of these patients include those with enteritis, short-bowel syndrome or obstruction, inflammatory bowel diseases, excessive ostomy losses, or decreased mucosal integrity because of age, medications, allergies, chemotherapy, or radiation therapy, liver disease, or hypermetabolism.
4. **Poor diet selection.** Examples of these patients include those who are ignorant of, or who misunderstand, diet and nutrition or who are unable to procure and prepare food because of lack of finances or other social factors.

Hospital-induced malnutrition is common and often results from the lack of attention given to meeting nutritional needs during selected diagnostic or treatment schedules and the push for shorter, more cost-beneficial hospital stays associated with new government reimbursement policies.

Prevention of hospital-induced malnutrition is critical to maximize quality of health care and to minimize hospital stay. Furthermore, appropriate nutrition support (a result of assessment followed by well-designed oral, enteral, or parenteral feedings) has been documented to be cost-effective and to significantly reduce morbidity and mortality.[2]

In light of new government reimbursement policies, it is mandatory that a patient's care be maximally effective. The DRGs (Diagnosis-Related Groups) have uncertain effects on reimbursement for nutritional care. In addition, frequent hospital readmissions may not be fully covered; this necessitates the prevention of nutrition-related complications.

Why is preventing hospital and home malnutrition such an issue?

In 1983, Congress passed the Tax, Equity, and Fiscal Responsibility Act (TEFRA), PL 98-21, amendments to the Social Security Act. This act establishes prospective Medicare payments for inpatient services according to 467 diagnosis-related groups (DRGs). DRGs are the result of a classification system that "partitions short-term, general hospital inpatients into a number of dynamic, comparable, mutually exclusive, statistically stable, clinically coherent, commonly reproducible, and anatomically organized groups."[5]

Reimbursement for medical care is therefore predetermined in terms of dollars. Such policy limits Medicare payments for medical care and necessitates careful scrutiny regarding testing for diagnostic purposes and treatment plans.

Health care professionals are required to provide careful screening and specific treatment to minimize the patient's stay. Hospital units are required to be self-supporting. Some units, including nutrition services, are

not only required to contain costs but also to be able to justify their need for service. The "per diem" charge is fast becoming a thing of the past as DRGs continue to be phased in.

As a result, hospital nutrition service departments are developing standards of practice, including assessment, planning, implementation, and evaluation strategies, which are deemed to be minimal nutritional care for each disease process or treatment mode. Desirable outcomes for each problem form the objective criteria for determining quality of care being provided to patients. These efforts are being expended because there is evidence that alleviation of malnutrition can reduce length of stay and increase response to treatment.[6]

As acute care admissions shorten in duration, ambulatory services will be in greater demand. Therefore, the inclusion of nutrition components in ambulatory medical practice, and perhaps incorporating the services of a registered dietitian, will ensure that the nutrition needs of the patient will be met. The following sections of this module will guide you in assessing and treating your patients to prevent malnutrition and maximize nutrition health.

Diagnostic Criteria for Identifying Malnutrition

Identification of malnutrition initially requires an assessment of nutritional status, including a collection of anthropometric, biochemical, dietary, and clinical data. Interpretation of these data can then allow you to determine if the patient needs nutrition attention so that your medical treatment can be maximized and the outcome of care can be positive.

The specifics of nutritional status assessment parameters have been delineated in Module 2, Appraisal of Nutritional Status, and in detail by Gray and Kaminski.[7] This section will be devoted to emphasizing the parameters you can easily assess in your practice.

Anthropometric Tests

Anthropometric techniques allow evaluation of body weight and estimation of degree of body fat and lean body mass. When performed regularly, they provide a more objective assessment of body composition than does visual inspection alone. Information easily obtained in the physician's office includes body weight, percent of ideal body weight, percent weight change, skinfold measurements (SF), and arm muscle circumference (AMC).

How do I determine body weight status?

Methods for calculating ideal body weight (IBW) and percent of IBW are offered in Appendix A-1. A body weight greater than 120% IBW is considered obese, while IBW ± 10% is considered ideal. Body weight less than 90% of ideal should be investigated further.

A person with a relatively greater lean body mass will have body weight greater than the calculated "ideal." Be sure to consider frame size and your subjective evaluation of body size via visual inspection; then adjust weight values accordingly.

How do I evaluate weight change in a patient?

A formula for determining weight changes is provided in Appendix A-1. An unintentional weight loss by your patient of greater than 10% in 3-6 months warrants questions related to reasons for loss, such as loss of appetite, change in lifestyle, social factors, or onset of disease.

Obesity is defined as overfat, not overweight or overheavy. To determine if the patient is overfat, use of tricep skinfolds (TSF) may be appropriate, especially when evaluating family members over long periods of time. See Appendix A in Module 2, Appraisal of Nutritional Status, for techniques, standards for interpretation, and limitations of use of TSF.

Example:

Patient A is a 50-year-old female, 5'4" tall (163 cm). Her current weight is 100 lb; her usual weight is 145 lb.

IBW? _____

What was her previous % IBW? _____

What is her current % IBW? _____

What is her % of usual weight? _____

What is her % weight change? _____

Answers:

IBW? **120 pounds** (100 pounds for first 5 feet plus 5 pounds for each inch over 5 feet)

Previous % IBW? **121%** (previous weight/ideal weight = 145/120 x 100)

Current % IBW? **83%** (actual weight/ideal weight = 100/120 x 100)

% Usual Weight? **69%** (current weight/usual weight = 100/145 x 100)

% Weight Change? **31%** (usual weight – current weight/ usual weight = 145-100/145 x 100)

Patient A could have been considered obese (121% IBW) at her usual weight; however, she is now 83% of IBW with a change of 31%; a more significant finding. An unintentional weight change of more than 10 percent is considered a risk factor for disease and generally reflects loss of energy stores.[7]

Loss of energy stores can be translated into diminished reserve that may be called upon when (1) caloric intake may be compromised, and when (2) increased energy requirements due to stress and disease are high. Changes in body weight may be due to true changes of body fat mass and/or lean muscle mass, or may be partially attributable to changing fluid balance.

When caloric intake is less than caloric expenditure, loss of stored fuel (glycogen, lean muscle mass, and adipose tissue) occurs. This loss can be detected as loss of body weight, which can also occur (without loss of stored fuel) by loss of fluid. One can easily monitor fluid balance by calculating intake and output (I&O). If intake exceeds output by greater than 500 cc daily, fluid accumulation is probable. Thus, the measured body weight may not be the person's "dry weight." Fluid overload can also skew the interpretation of electrolyte status. Remember that 10 pounds of fluid must accumulate to be clinically appreciated by either patient or physician.

A baseline arm-muscle circumference should be considered for the patient's chart when a steady state is reached in the twenties. Beware that beyond age 60 the normal values change moderately each decade.

The patient's lean body mass can be assessed serially and easily in your office using arm-muscle circumference measurements. Specifics of this technique are presented in Appendices A-2 and 3 and Module 2, Appraisal of Nutritional Status.

Biochemical Tests

Biochemical parameters useful in detecting malnutrition include measurements of somatic and visceral proteins. Visceral proteins, such as albumin or prealbumin, transferrin, retinol-binding protein, acute-phase reactants, lymphocytes, and skin test antigens, are required for functioning of visceral organs and the immune system. With the exception of albumin, they tend to respond quickly to changes in diet and reflect overall energy and protein status. Skin testing also tests immune competence, specifically cell-mediated immunity. These tests are often used to determine if a patient will be able to withstand the stress of surgery or medical treatment in his/her current nutritional state (Appendix B). The lack of visceral reserve will put the patient at risk for loss of normal body function and for inability to mount an appropriate immune response (normal values and values for moderate and severe deficit are included in Appendix B).

If somatic and visceral protein compartments are depleted, the patient will be at high risk for sepsis and mortality and will have difficulty responding to medical and surgical treatments.

Additional biochemical parameters include measurement of nitrogen balance and creatinine-height index (CHI). Nitrogen balance requires estimation of nitrogen intake minus urinary nitrogen output (24-hour urinary urea nitrogen) plus a "fudge factor" for fecal and other nitrogen losses (see Appendix A-1 for formula). Nitrogen balance is best used serially (such as weekly) to monitor changes in protein status.

The creatinine-height index estimates the amount of muscle mass per patient height and is compared to standards of creatinine excretion for healthy individuals of identical height. (See Appendices A-4 and B for standards.) A high 24-hour urinary creatinine assumes muscle wasting. This may be caused by loss of lean body mass to meet energy needs, often a case of simple starvation or marasmus.[7]

Measurement of somatic proteins, visceral proteins, and cell-mediated immunity in a serial fashion allows you to determine the effectiveness of a nutritional therapy you may institute. A sample patient nutrition profile and worksheet with these parameters are given in Appendix C.

Clinical Tests

Clinical signs of compromised nutritional status imply a long-standing, sub-optimal nutrient intake. Clinical signs, such as muscle and fat wasting, edema, and skin and hair changes, are the last to develop following loss of tissue stores which are reflected in biochemical parameters (Table 25-1).

Dietary Intake Tests

Finally, dietary intake history yields extremely important data on quality and quantity of nutrient intake. Inadequate oral intake can be due to a host of problems or conditions and will result in medical risk. Assessing nutritional status should also include an assessment of the patient's medical problem(s) which may alter nutrient needs and/or prevent adequate intake. Disease-related malnutrition may be easier to detect than poor status related to anorexia or aberrant food practices.

To obtain food intake data, a simple 24-hour recall of dietary intake can be taken by your office receptionist or nurse and then analyzed according to the four basic food groups (Appendix D). Appendix E, Patient Assessment Worksheet, includes a section for quick determination of needs and evaluation of intake.

Computerized nutritional assessment packages are also available to evaluate a patient's intake and needs. Programs vary in the extent of information provided. The July, 1984, issue of the *Journal of Nutrition Education* provides a comprehensive review of available nutrition assessment programs.

Specific Criteria For Identifying Potential Nutrition Problems

The adequacy of patient food intake during hospitalization is affected by the typical procedures used to assess and to treat the patient. The composition of the diet is also affected by the standard diet orders given by the physician. Planning work-up and treatment with nutritional status in mind is crucial to successful (and shorter) hospital stay.

How does the number of days a patient is receiving clear liquids affect nutritional status?

The typical clear liquid diet (juices, broths, gelatin, tea, coffee) is inadequate in all nutrients and provides only 500-600 kcal/day. It should not be the sole nutrition source for more than 48-72 hours, especially if your patient is marginally malnourished. If the patient is not a candidate for other oral or enteral nutrition, commercial residue-free preparations are available. (Residue-free commercial preparations will be discussed later and are listed in Tables 25-6 and 7 and Appendix H.) If the patient can advance to full liquids, adequate nutrition is more readily achieved.

Why do gastrointestinal work-ups or other procedures cause concerns about nutritional status?

Patient work-up usually includes tests on consecutive days that require "holds" on meals and extended periods of NPO (nothing by mouth). Series of tests planned on consecutive days can limit patient intake to 1 meal a day. Further, cancellation of tests means unnecessary withholding of nourishment. Lack of communication with laboratories regarding testing procedures can negatively impact on nutritional care. Planning tests for early morning which require NPO status for 12 hours (e.g., overnight fast) is much wiser than planning these tests for noon or later since meals will be missed.

What other treatments or procedures are potential causes of nutritional problems?

The debridement of a burn patient, physical therapy, and radiation or chemotherapy are identifiable causes of nutritional problems. Timing of treatment and planning of the diet in terms of timing and composition are necessary. Suggestions for such preplanning will be presented in the section "Strategies to Improve Nutrition Care in the Hospital."

How does preoperative status of a patient affect surgical outcome?

Rigorous and lengthy preoperative testing can compromise nutritional status and can result in delayed wound healing and depressed immune response postoperatively. The stress of surgical catabolism inherent in the procedure, plus steroid therapy which may follow, increases metabolic demand. Thus, it seems apparent that trying to maintain an adequate preoperative diet can be important to the patient's overall response and length

Table 25-1 Clinical Nutrition Examination

Clinical findings	Consider deficiency of	Consider excess of
Hair, nails		
Flag sign (transverse depigmentation of hair)	Protein, copper	
Hair easily pluckable	Protein	
Hair thin, sparse	Protein, biotin, zinc	Vitamin A
Nails spoon-shaped	Iron	
Nails lackluster, transverse ridging	Protein-calorie	
Skin		
Dry, scaling	Vitamin A, zinc, essential fatty acids	Vitamin A
Erythematous eruption (sunburn-like)		Vitamin A
Flaky paint dermatosis	Protein	
Follicular hyperkeratosis	Vitamins A, C; essential fatty acids	
Nasolabial seborrhea	Niacin, pyridoxine, riboflavin	
Petechiae, purpura	Ascorbic acid, vitamin K	
Pigmentation, desquamation (sun-exposed area)	Niacin (pellagra)	
Subcutaneous fat loss	Calorie	
Yellow pigmentation sparing sclerae (benign)		Carotene
Eyes		
Angular palpebritis	Riboflavin	
Band keratitis		Vitamin D
Corneal vascularization	Riboflavin	
Dull, dry conjunctiva	Vitamin A	
Fundal capillary microaneurysms	Ascorbic acid	
Papilledema		Vitamin A
Scleral icterus, mild	Pyridoxine	
Perioral		
Angular stomatitis	Riboflavin	
Cheilosis	Riboflavin	
Oral		
Atrophic lingual papillae	Niacin, iron, riboflavin, folate, vitamin B_{12}	
Glossitis (scarlet, raw)	Niacin, pyridoxine, riboflavin, vitamin B_{12}, folate	
Hypogeusesthesia (also hyposmia)	Zinc, vitamin A	
Magenta tongue	Riboflavin	
Swollen, bleeding gums (if teeth present)	Ascorbic acid	
Tongue fissuring, edema	Niacin	

Clinical findings	Consider deficiency of	Consider excess of
Glands		
Parotid enlargement	Protein	
"Sicca" syndrome	Ascorbic acid	
Thyroid enlargement	Iodine	
Heart		
Enlargement, tachycardia, high output failure	Thiamine ("wet" beriberi)	
Small heart, decreased output	Calorie	
Sudden failure, death	Ascorbic acid	
Abdomen		
Hepatomegaly	Protein	Vitamin A
Muscles, extremities		
Calf tenderness	Thiamine, ascorbic acid (hemorrhage into muscle)	
Edema	Protein, thiamine	
Muscle wastage (especially temporal area, dorsum of hand, spine)	Calorie	
Bones, joints		
Beading of ribs (child)	Vitamins C, D	
Bone and joint tenderness (child)	Ascorbic acid (subperiosteal hemorrhage)	Vitamin A
Bone tenderness (adult)	Vitamin D, calcium, phosphorus (osteomalacia)	
Bulging fontanelle (child)		Vitamin A
Craniotabes, bossing (child)		Vitamin D
Neurologic		
Confabulation, disorientation	Thiamine (Korsakoff's psychosis)	
Decreased position and vibratory senses, ataxia	Vitamin B_{12}, thiamine	
Decreased tendon reflexes, slowed relaxation phase	Thiamine	
Drowsiness, lethargy		Vitamins A, D
Ophthalmoplegia	Thiamine, phosphorus	
Weakness, paresthesias, decreased fine tactile sensation	Vitamin B_{12}, pyridoxine, thiamine	
Other		
Delayed healing and tissue repair (e.g., wound, infarct, abscess)	Ascorbic acid, zinc, protein	
Fever (low-grade)		Vitamin A

From Weinsier, R.L., and Butterworth, C.E., Jr.: *Handbook of Clinical Nutrition*. St. Louis: C.V. Mosby, 1981, pp. 30-31. Used with permission of the publisher.

of the recovery period. Preoperative use of total parenteral nutrition (TPN) for 2-3 days can minimize post-surgical risks.

Delay in postoperative healing is also affected by adjunctive medical therapy. A good example is when cancer surgery is followed by a course of radiation or chemotherapy. Use of more aggressive nutrition therapies to overcome these added insults to recovery will be outlined in the section "Strategies to Improve Nutrition Care in the Hospital."

What other pre-existing conditions can threaten the nutritional status of the newly hospitalized patient?

Several medical conditions may compromise a patient's nutritional status and, therefore, should be considered when trying to identify patients with potential problems. Does the patient have a history of

1. Cancer therapy?
2. Alcoholism?
3. Steroid therapy?
4. Anorexia?
5. Loss of taste and smell?
6. Malabsorption or maldigestion (i.e., pancreatic or biliary disease)?
7. Nausea and vomiting?
8. CNS disturbances (i.e., stroke, ALS, Alzheimer's disease, para- or quadriplegia)?
9. Hypertension, diabetes, or other systemic disease?
10. Arthritis?
11. Emotional problems?
12. Economic problems?

These factors may affect the patient's ability to procure, prepare, consume, and utilize food.

It is becoming increasingly apparent that many of the therapies used in patient care have specific effects on nutrient absorption. These therapies include drugs or other medical therapies and surgical resections. The physician should keep these therapies and their effects in mind in light of the goals to decrease hospital or home malnutrition and unnecessary admissions.

What are some of the specific interactions that can occur between treatment and nutrition?

Medical and surgical therapies have short-term and long-term effects. Effect on appetite is the most common. While changes in appetite are important to assess in all age groups, the elderly are particularly vulnerable to depressed intake. The elderly frequently have compromised dietary intake and are the largest single- and multiple-drug consumer group.[8] The intention here is to identify the most notable problems to the primary care practitioner.

Interactions between drug therapy and nutrition can be categorized in several ways. Complete discussion of these interactions has been provided in Module 3, Nutrient and Drug Interaction. Your questions about drug and diet interactions should include the following:

1. Does the drug affect food ingestion?

Ma. y drugs alter taste and smell, two senses critical to the patient's perception of food and desire to eat. Some drugs may depress appetite, such as psychiatric medications, antibiotics, antineoplastics, cardiac glycosides, and ethanol. Other drugs, such as steroids, hypoglycemic agents, antihistamines, certain tricyclic antidepressants, and phenothiazines, stimulate appetite and may cause hyperphagia; their use may be contraindicated for some systemic diseases. They may be useful, however, when appetite is depressed and side effects are not of major importance, such as in hospice patients or other terminal patients who desire the pleasure of eating.

2. Does the drug affect food digestion, absorption, or nutrient utilization?

Drugs that disrupt digestion may produce malabsorption of nutrients. Some drugs compete with nutrients for binding sites in the gut, thereby producing malabsorption of both, while other drugs inhibit transport or utilization of available nutrients and may cause biochemical or frank clinical deficiencies.

Use of drugs that decrease nutrient absorption should be monitored. Specifically, use of these drugs in the elderly requires special attention since this age group frequently has altered gastrointestinal motility, tone, and absorptive capacity. If possible, these drugs should be given before meals, or at least two hours following meals, to permit maximum food digestion and absorption. Chronic use of medicines such as these may warrant your suggestion that the patient take a general multivitamin and mineral supplement.

3. Can the drug's effectiveness be affected by food ingestion?

The presence of food in the gastrointestinal tract may reduce gastric emptying, alter pH so as to render a drug less effective, or affect solubility and activity of the drug. Drug utilization can be altered by the presence (or absence) of food or by specific nutrients.

Prolonged use of over-the-counter drugs, including antacids and laxatives, should be questioned. Dose, frequency of ingestion, and timing should be assessed in relation to the patient's typical dietary intake to determine if the drug is affecting food intake, digestion, absorption, and/or utilization.

One last point to remember is that drug absorption and utilization are altered in the malnourished. The turnover of gut absorptive cells is rapid and thus easily affected by poor nutrition. With poor absorptive ability, drugs are not well absorbed. Blood protein carriers of drugs, such as albumin, may also be diminished in the malnourished patient; therefore, drug transport is compromised. With limited body fat or lean muscle mass, drug effectiveness may be compromised when drug utilization depends on adequate amounts of these tissues. A malnourished patient responds abnormally to anesthesia; these and many other nutrient-drug considerations in the malnourished patient have been explored by Roe.[9]

What are the nutritional side effects of cancer therapy, chemotherapy, radiotherapy, and surgery?

Nutritional side effects of cancer therapy have been discussed elsewhere.[10,11,12] Often radiation and chemotherapies produce extreme nausea and vomiting, even before administration, because of conditioning. Use of antiemetic treatment is not highly successful. Some antiemetics, such as Ativan and prednisone, given up to one day before therapy, have been shown to reduce anticipatory nausea and vomiting.

Questions that should be directed to the patient to assess existence of nutrition problems include:

1. Do you experience nausea and/or vomiting? If so, when? Food should be provided well in advance of the expected episode.
2. Is your mouth sore? Encourage the patient to avoid spicy, acidic, dry, or rough-textured foods. High-calorie liquids, such as milkshakes, eggnogs, custards, and soups, are often well tolerated.
3. Is your mouth dry? Increase liquids, casseroles, gravies, and juicy foods; perhaps, try an artificial saliva.
4. Do foods taste differently than usual? If the taste is undesirable, avoid the foods. Usually beef, pork, and lamb (red meats) taste bad, while milk, eggs, cheese, chicken, and fish are more preferred.
5. What is your best meal of the day? Eat a large amount at this meal; if it is at breakfast, breakfast foods may also be desired for lunch and dinner.

Surgical intervention for cancer or other conditions also affect nutritional status. The following four effects comprise the physiologic response in injury; each has related nutritional side effects: (1) neuroendocrine, (2) cardiovascular, (3) response to necrotic tissue, and (4) starvation response if postoperative intake is not monitored.[13]

Unlike starvation, stress is characterized by increased glucagon and catecholamine release, increased blood pressure, increased metabolic rate, and increased protein catabolism. These changes result in increased gluconeogenesis and active protein synthesis at the site of injury, including the acute phase proteins, immune proteins, and proteins for tissue repair.

Like other stress responses, the metabolic changes associated with surgery vary with the duration and intensity of the stress. The most critical dietary component is provision of adequate energy and protein. Other nutritional implications of surgery vary with the type of surgery, especially when surgery is of the gastrointestinal tract.

What are some oral surgeries that affect nutritional status?

Oral Surgery

Oral surgery for cancer, such as maxillectomies, mandibulectomies, and glossectomies, produce drastic changes in anatomy and loss of muscle tone around the oral cavity. Maxillofacial prosthetics can restore fairly normal structure and function; however, patients who are not candidates for or cannot adjust to prosthetic devices will need extensive dietary counseling with regard to diet composition and techniques of feeding. Although you may not have these patients often, it is important to achieve maximum nutritional status when planned treatment is aggressive.

Gastric Surgery

Reconstruction following partial gastrectomies, with

or without vagotomy, varies, and diet therapy will depend on the procedure. Gastroduodenostomy versus gastrojejunostomy has obvious effects on absorption of specific nutrients. Concomitant vagotomy will affect acid production and drainage. All of these factors should be kept in mind for postoperative feeding.

The most pronounced changes in a patient's nutritional status occur if the patient experiences the dumping syndrome or the short-bowel syndrome. Meal size, carbohydrate tolerance, and gastric emptying must be assessed if the dumping syndrome occurs. Procedures for treating various complications following gastrectomy are presented in Table 25-2. Factors that specifically affect gastric emptying include food texture, food temperature, and nutrient-density of foods. Liquid foods and foods at cold temperatures increase the rate of emptying. High-fat foods and energy- and nutrient-dense meals tend to slow the rate of gastric emptying, which may improve absorption. A specific protocol for feeding when dumping occurs is provided in the Patient Handout, "Nutritional Management of Dumping Syndrome."

Intestinal Surgery

The small intestine is the site of most food digestion and nutrient absorption (Table 25-3). The fluid volume entering and leaving the gut varies; but, on the average, the jejunum, ileum, and colon absorb 4.5, 3.5, and 1 liter of fluid, respectively. Thus, intestinal resection greatly affects fluid balance.

The most common nutrition problem associated with intestinal resection is malabsorption. After intestinal surgery, the patient must be monitored for nutrient malabsorption and fluid and electrolyte imbalance. If the patient is malabsorbing, feedings may need to be in a more elemental form, and enzyme replacement may be needed for proper digestion.

True malabsorption of nutrients occurs with disorders such as enteritis, fistula resections, enteropathies, inflammatory bowel diseases, or short-bowel syndrome. True malabsorption poses a real challenge to the physician and dietitian. Oral and enteral modes of feeding may work, but these patients are often candidates for total parenteral nutrition, via peripheral or central lines.

Use of ostomies requires special mention at this time. The patient with an ileostomy may begin with liquid intake, progressing to a low-fiber diet, and eventually to a regular diet. These patients need increased fluid and salt intake equal to ostomy output as long as the

Table 25-2 Complications of Gastrectomy

Problem	*Dietary Management*
1. Dumping syndrome	Allow foods per patient tolerance. Begin by reducing simple sugars and encouraging complex carbohydrates (100-200 grams daily of total carbohydrates). Provide fat as 30-40% of total calories. Provide source of protein at each feeding. Begin feedings with dry, frequent feedings, restricting fluids before or 1-2 hours after meals. Encourage the patient to eat slowly. Assess lactose tolerance. Progress to regular diet gradually by adding simple sugars, adding fluids to meal, and decreasing meal frequency within 2-3 months.
2. Diarrhea	Begin with small, frequent dry feedings. Allow fluids 2-3 hours before or after meals. As diarrhea stops, resume normal diet.
3. Weight loss	Determine and treat the cause.
4. Anemia	Determine and treat the cause. Common causes are iron deficiency due to inadequate intake or bacterial overgrowth, vitamin B_{12} deficiency due to loss of intrinsic factor, or folate deficiency.
5. Phytobezoars	Prescribe low-fiber, high-fluid diet.
6. Metabolic bone disease	After a Billroth II, increase dietary calcium (1-2 gm daily) and vitamin D (400-800 IU daily).

Table 25-3	Sites of Absorption
Duodenum	Sugars Amino acids Water
Jejunum	Calcium Sugars Amino acids Iron Fat Water
Ileum	Vitamin B_{12} Bile salts Water
Colon	Water Electrolytes

ileostomy is in place. Foods that can obstruct the ostomy, such as high-fiber and high-residue foods, need to be avoided.

The nutritional needs of the colostomy patient depend on the site of the ostomy. Feeding the patient with a right-sided or transverse colostomy is essentially the same as the patient with an ileostomy. The individual with a left-sided colostomy is more likely to have problems with constipation or diarrhea. Adequate fluid intake is always essential. Fiber intake should be encouraged, the amount of which depends on patient tolerance.

Not all gastrointestinal surgical patients require extraordinary means of nutrition support. If a patient is in good nutrition status preoperatively, and if the postoperative course is expected to be uneventful, the patient can do well for 3-7 days without nutrition support other than intravenous infusion of fluid, dextrose, and electrolytes. The expense of total parenteral nutrition (TPN) is not justified unless it is medically necessary.

What are some other medical problems associated with nutritional risk?

Ventilator-Dependent Pulmonary Disease

The patient who is ventilator-dependent requires frequent monitoring. Anorexia from both treatment and medications is common, and malnutrition adversely affects respiratory muscle function. Aspiration is also a potential problem in feeding these patients. Increased calories are needed for breathing expenditure and restoration of muscle integrity. Achievement and maintenance of ideal body weight reduce the restrictive effects of obesity on breathing.

Moderate carbohydrate restriction (between 30-35% of total calories) is indicated if the patient with pulmonary disease cannot excrete the carbon dioxide produced from carbohydrate metabolism. Mouth breathers may eat better if fluids, instead of solid foods, are encouraged.

Reducing stress from anxiety or emotional trauma will result in a better response to treatment. You may want to consider biofeedback or relaxation therapy to reduce the problems associated with psychological stress.

Infection and Sepsis

Metabolic changes typically seen in acute infection and sepsis include an increase in serum catecholamine and glucagon levels, increased metabolic rate, negative nitrogen balance, and loss of potassium, phosphorus, magnesium, sulfur, and zinc. The negative nitrogen balance reflects skeletal muscle breakdown, increased catabolism of branch-chain amino acids, gluconeogenesis, and impaired synthesis of acute phase reactants and immune proteins. Increased gluconeogenesis and a mild insulin resistance produce hyperglycemia. Lipid metabolism may be altered in that lipid clearance may be impaired and ketogenesis occurs. Thus, calorie and protein requirements may increase 200% and 50%, respectively. Sepsis and infection appear to increase the need for vitamins A, C, and E, as well as potassium, magnesium, iron, phosphorus, and copper.

Past dietary habits of the patient influence health and development of disease. Inadequate nutrient intake may predispose a patient to nutrient deficiencies. Excess caloric intake over a lifetime may place the patient "at risk" of diseases refractory to treatment. In addition, environmental and social influences such as stress impact on food consumption and nutrient utilization. This may affect the ability of the patient to tolerate insults in the form of disease.

How do past dietary practices relate to potential nutrition problems in the hospitalized patient?

The significance of the diet history as part of a total social history is covered in Modules 2 and 17. The purpose of this discussion is to explore the common deficiencies of macro- and micronutrients and their significance to disease development.

Energy Intake

A deficiency of food energy intake is not a common problem for most of us; but when long-standing energy malnutrition does occur, a number of metabolic problems can arise, especially if a stress is superimposed on the individual. Conversely, stress can precipitate calorie or nutrient deficit.

The caloric need of an individual can be calculated in a variety of ways. Perhaps the most simple estimation of energy need is:

ideal body weight in pounds x 10 kcal/lb = kcal for weight loss

ideal body weight in pounds x 15 kcal/lb = kcal for weight maintenance

ideal body weight in pounds x 20 kcal/lb = kcal for weight gain

OR

ideal body weight in kg x 22 kcal/kg = kcal for weight loss

ideal body weight in kg x 33 kcal/kg = kcal for weight maintenance

ideal body weight in kg x 44 kcal/kg = kcal for weight gain

Others have developed an estimation of resting energy needed for use in the malnourished as follows[7]:

Resting energy need = 25-30 kcal/kg/ideal body weight/day

Malnourished patient's need = 35-40 kcal/kg/day

To obtain the patient's total caloric needs, factors for stress and activity level need to be added using the following formulas:

Total Energy Need = Resting Need x Stress Factor x Activity Factor

where,

Stress factors include:

Elective surgery	Resting need x 1.24
Skeletal trauma	Resting need x 1.32
Blunt trauma	Resting need x 1.37
Head trauma & steroid therapy	Resting need x 1.61
Sepsis	Resting need x 1.79
Burns	Resting need x 2.00

and,

Activity factors include:

Comatose patient	Resting need x 1.0
Bed-ridden patient	Resting need x 1.2
Ambulatory patient	Resting need x 1.3

Example:

The Total Calorie Need of a 170-pound (ideal body weight) patient who is hospitalized for skeletal trauma and is bed-ridden would be as follows:

Resting Energy Needs:

170 lb (77 kg) x 25-30 kcal/kg body weight = 1925-2310 = 2117 kcal average

Total Caloric Needs = Resting Needs x Stress Factor x Activity Factor

therefore,

Total Caloric Needs = 2117 x 1.32 x 1.2 = 3350 kcal/day for weight maintenance

Effects of Energy Deficit

Reduced energy stores, particularly in the stress state, mean sacrifice of lean body mass and impaired synthesis of plasma proteins, acute-phase reactants, and substances required for immune function and wound healing. Cardiac cachexia is a major complication of prolonged starvation. Correction of malnutrition is required for optimal effect of medical therapy.

Protein Intake

Protein need in healthy persons is calculated using the Recommended Dietary Allowances (RDA) for protein as follows (Appendix F):

Adult Male	0.8 gm/kg body weight/day
Adult Female	0.8 gm/kg body weight/day
Adolescent	1-1.2 gm/kg body weight/day
Child	0.6-0.8 gm/kg body weight/day
Infant	2.0-2.2 gm/kg body weight/day

Protein needs for ill adults may also be estimated using formulas by Gray and Kaminski[7]:

Resting Protein Need	0.7-1.0 gm/kg body weight/day
Malnourished	1.2-1.5 gm/kg body weight/day
Stressed	1.5-2.0 gm/kg body weight/day

Exceptions to feeding protein in these amounts include primary acute or chronic renal or liver failure. Provision of essential amino acids (EAA) in renal failure allows utilization of urea for synthesis of nonessential amino acids. Feeding branched-chain amino acids (BCAA) in liver failure has been shown to favorably affect the ratio of BCAA to aromatic amino acids and, in some cases, to improve symptoms of liver disease and reduce muscle catabolism.

A quick means of evaluating protein intake from patients' diet histories is presented in Appendix E, Patient Assessment Worksheet.

Signs of protein deficiency or kwashiorkor can develop quickly, particularly in the presence of concurrent stress.

Depressed synthesis of labile proteins occurs with inadequate protein intake. Especially affected are plasma proteins (albumin, prealbumin, and retinol-binding protein). Prealbumin and retinol-binding protein are better estimates of recent protein intake than albumin since the half-life of prealbumin is 2-3 days and that of retinol-binding protein is 1/2 day. Albumin half-life is about 20 days. Decreased oncotic pressure secondary to decreased serum albumin causes the typical edema seen in kwashiorkor. Delayed wound healing and infection are the result of depressed synthesis of collagen, cellular proteins, and immune proteins.

Fat and Carbohydrate Intake

Fat and carbohydrate deficiencies rarely occur in the clinical setting. An exception is adherence to a ketogenic diet when low or no carbohydrate is included and in TPN patients receiving no essential fatty acids. A minimum of 100 gm carbohydrate/day, or 1/4 to 1/3 of total energy intake, has been used as a recommended intake to prevent ketosis. Other situations requiring limits on carbohydrate intake include the ventilator-dependent patient, especially one receiving TPN and being weaned from the ventilator. It is suggested that carbohydrate intake not exceed 30-35% of kilocalories in these patients, fat being 50-55%, and protein 10-20%.

Vitamin and Mineral Intake

An exhaustive discussion of vitamin and mineral deficiency states is not within the scope of this module (see Module 23, Vitamins and Trace Minerals). However, it is appropriate to review the more commonly encountered deficiencies and their implications for prevention of hospital and home malnutrition by the physician.

Criteria for assessment of adequacy of nutrient intake may be derived from either analysis of intake from the diet or by laboratory analysis. Evaluation of dietary intake can be via 24-hour recall, frequency of foods consumed, or the keeping of a food diary for 3 or more days.

A dietitian can assist the physician by calculating a patient's vitamin and mineral intake using food composition tables or computerized nutrient analysis programs. Typical intakes should then be compared to a standard, generally the Recommended Dietary Allowances (Appendix F). The Recommended Dietary Allowances, based on needs of the healthy U.S. population, were not developed for use by ill persons. It can be assumed, however, that the further a person's intake deviates from the RDA, the more likely one is to develop a nutrition-related problem.

An alternative method of assessing the adequacy of nutrient intake is the laboratory evaluation. Normal biochemical values and values considered "at risk" are presented in Appendix G.

The relationship of vitamins and minerals to nutritional anemias and immune function has recently been more fully appreciated. Anemias can be due to decreased red blood cell production, increased cell destruction, and blood loss (Table 25-4). To best treat anemias, it is essential to know which types can be remedied with diet.

Nutrition anemias can be a result of the deficiency of a number of nutrients, including protein, iron, copper, folic acid, vitamin B_{12}, vitamin C, and vitamin E; less often the deficiency involves vitamin A, lead, copper, and cadmium. Table 25-5 lists the associations.

Deficiencies of these nutrients can be primary (i.e., due to lack of the nutrient in the diet) or secondary due to disease (i.e., bone marrow failure, leukemia, renal or hepatic disease, endocrine disorders, hemorrhage, and medications). A simple method to assure adequate intake is to quickly view the patient's typical intake and compare it to the recommendations of the USDA and

Harvard University Department of Nutrition in the Daily Food Guide. A copy of this guide is distributed by the National Dairy Council and is intended for public education (see Guide to Good Eating, Appendix D).

The relationship between nutrition and immune function is becoming better understood. It is well documented that immune status is related to resistance to infection and recovery following surgery. To prevent infection and maximize tolerance to certain therapies, nutrition, as it relates to immune function, should receive your attention.

Cell-mediated immunity (T-lymphocytes) responds to nutrition therapy, whereas mediators of the humoral response (B-lymphocytes or their products, immunoglobulins) have variable responses to direct nutrition intervention.

Protein malnutrition is associated with decreased numbers of T-cells, thymic hormones, and production of mediators. Humoral agents, on the other hand, have variable responses to protein deficiency; B-cells and plasma cells may remain normal or may increase with protein deficiency. Phagocytic function is depressed in protein deficiency.[11]

Lipids affect immune function in that esterified fatty acids have been shown to stimulate T-cell mitosis, while excessive amounts of both polyunsaturated fatty acids and saturated fatty acids may depress T-cell function. Excessive levels of serum cholesterol and high-density lipoprotein levels may also be immunosuppressive.[11,14]

Specific nutrients have been thought to affect immune function by mechanisms yet to be fully elucidated. In animal models, vitamin A, pyridoxine, vitamin C, and folic acid deficiencies have consistently impaired T-cell formation. Deficiencies of antioxidants (vitamins C, E, and A) may also result in impaired immune function.[14]

Iron deficiency has been shown to produce impaired lymphocyte stimulation response and impaired bacteriocidal activity of neutrophils, causing significant increases in morbidity and mortality after challenge.[14] Other trace elements that play a role include zinc, copper, selenium, and possibly chromium. According to Chandra,[14] most heavy metals suppress immune function.

Protein losses of any kind, immunosuppressive ther-

Table 25-4 Causes of Anemias

Anemias due to decreased red blood cell production
- Normocytic anemias
  - From primary bone marrow failure
    - Aplastic anemia
    - Myelopathic (e.g., leukemia-related) anemias
  - From secondary causes
    - Chronic inflammation
    - Uremia
    - Hepatic disease
    - Endocrine disorders
- Megaloblastic (macrocytic) anemias
  - From primary nutritional deficiencies
    - Vitamin B_{12}
    - Folic acid
    - Thiamine and pyridoxine (rare)
  - From secondary causes
    - Drugs acting as B_{12} and folate antagonist
    - Orotic aciduria
    - Erythroleukemias
    - Pernicious anemias
- Microcytic anemias
  - From primary nutritional deficiencies
    - Iron
    - Pyridoxine (sideroblastic anemia)
    - Ascorbic acid and vitamin A deficiency
  - From other causes
    - Hemorrhage
    - Forms of thalassemia
    - Drugs and heavy metal intoxication (e.g., lead, cadmium)

Anemias due to increased destruction of red blood cells
- Hemoglobinopathies
  - Sickle cell anemia
  - Thalassemia
- Hemolytic anemias
  - From primary nutritional deficiencies: vitamin E
  - From secondary causes
    - Favism
    - Glucose-6-phosphate dehydrogenase deficiency
    - Drugs
    - Mechanical damage
    - Infection (e.g., malaria)
    - Immunologic disorders

From Zeman, F.J.: *Clinical Nutrition and Dietetics.* Lexington, Mass.: Collamore Press, 1983, p. 544. Used with permission of the publisher.

apy, and advancing age negatively affect T-cell numbers and function. The very young (especially low birthweight) and elderly generally have impaired immune function. The ability of the patient to withstand insult and respond to treatments is directly related to nutrient intake as well as to the patient's stores or reserves.

Strategies to Improve Nutrition Care in the Hospital

Numerous strategies exist to improve nutritional care of the patient during hospitalization. Utilizing aggressive nutrition support techniques, including oral, enteral, or parenteral nutrition, can promote recovery and shorten patient hospital stay.

Assessing the patient for baseline status is the first step in planning nutrition care. Continuing assessment in a serial fashion and routine monitoring allow evaluation of effectiveness of the treatment. Many hospital nutrition services have worksheets, and a dietitian can assist in developing your own nutrition worksheet. Module 15, Nutritional Care of Deteriorating Patients, presents details of the methods of providing nutrition support. The purpose of this section is to provide examples of the different modes of nutrition support and when each is indicated.

How can I more effectively work around treatment schedules?

If the patient is scheduled for morning tests (IVP, BaE, UGI), breakfast can be ordered specifically to be served following the test so that the patient will not need to wait for lunch. If tests are anticipated in the afternoon, some morning nourishment might be allowed (excepting for UGI); a complete meal the night before is encouraged. The physician should work with laboratory and radiology personnel if morning tests are routinely delayed until afternoon. It is important to provide evening snacks the night prior to early morning debridement or other therapy when breakfast will not be allowed.

Timing of meals should include consideration of time spent in patient transportation to and from therapy. Therapies, including chemotherapy, should also be given several hours after a meal to allow digestion and absorption of food eaten earlier. Infusion of chemotherapy may also be given during the night to prevent adverse effects on intake.

Table 25-5 Mechanisms by Which Common Nutrition-Related Anemias Are Promoted

Anemia	Causative Nutrient or Food Component Deficiency	Mechanism
Macrocytic	Vitamin B_{12} and folic acid	Decreased DNA synthesis that retards or inhibits cell division
	Thiamine and pyridoxine	Presumed to be related to decreased DNA synthesis owing to impaired purine synthesis
Microcytic	Iron	Reduced heme synthesis and, subsequently, hemoglobin synthesis
	Ascorbic acid	Presumed to be related to decreased iron utilization
	Vitamin A	Presumed to be related to increased iron storage so that iron is not available for heme synthesis
	Vitamin E	Presumed to be related to decreased heme synthesis
	Pyridoxine	Reduced heme synthesis
	Lead	Reduced heme synthesis
	Copper	Reduced iron use and release for heme synthesis
	Cadmium	Reduced iron and copper use
Hemolytic	Vitamin E	Impaired integrity of red blood cell membrane, which leads to increased susceptibility to damage by oxidants

From Zeman, F.J.: *Clinical Nutrition and Dietetics.* Lexington, Mass.: Collamore Press, 1983, p. 545. Used with permission of the publisher.

Dietitians, occupational therapists, and physical therapists combine their efforts to restore patients' abilities to prepare and eat food. For example, the stroke or paraplegic patient should be assessed for access to and knowledge of how to utilize adaptive equipment if needed, and to determine if the patient is able to procure suitable foods in the hospital or home setting. Nutritional needs of stroke and CNS-damaged patients include maintaining a fluid intake of 2-3 liters per day, along with adequate fiber to prevent constipation. Lack of activity contributes to obesity and tissue breakdown with occasional significant nitrogen losses. The resting energy need in the spinal-cord-injured patient has been estimated to be 50-80% below the resting energy need for able-bodied persons.[15]

What are some specifics about available means of nutritional support?

Oral Feedings

Many of your patients will need only a regular (standard house) diet during hospitalization. In general, the regular diet, depending upon patient self-selection, provides 1800-2200 kcal, 60-70 gm protein, 100% RDA of vitamins and minerals, 1000-2000 cc fluid, and 4-8 gm sodium. If your patient's needs will not be met by the regular diet or if restrictions are necessary, the regular diet can be modified, as shown in Table 25-6.

If the patient cannot tolerate solid foods, consider liquid diets. These diets are commonly used pre- and post-operatively and in situations where solids are not tolerated, such as with vomiting and partial obstructions.

A standard clear liquid diet given six times per day provides hydration and approximately 500 kcal. It is nutritionally inadequate. Many institutions provide nutritionally complete, low-residue supplements and modular feedings (Table 25-6) to add nourishment to the standard clear liquid diet. These are cost-beneficial if the patient needs supplementation for longer than 48 hours. Patients who were well-nourished at the time of admission, and who are undergoing minimal stress, may not need supplementation for 72 hours or longer.

A standard full liquid diet, such as juices, ice cream, strained soups, gelatin, milk, eggnogs, puddings, custards, and milkshakes, provides a much wider variety of foods. Commercial supplements (Table 25-6) can supplement or replace the full-liquid diet. Modular components are available to individualize a patient's feedings by adding specific nutrients, such as protein, carbohydrate, or fat (Table 25-6). These products add few vitamins or electrolytes but add single nutrients as needed. Details regarding composition of each supplement are provided in Appendix H.

Any of these supplements can be used at home. They are easy to use and readily available for patients who are disabled or live alone. However, the cost of commercial supplements may be a limiting factor in your patient's use of them. The ease of use and ready availability for the patient living alone or who is disabled makes the supplements an excellent source of nutrition.

Enteral Feedings

Nasogastric or gastric enteral feedings are the best choice for providing nutritional support to patients who have normal digestive and absorptive capacity but who are traumatized around the head, neck, or thoracic region, or who may be in a coma. Gastric (and possibly jejunostomy) tubes may preferable for a patient who continually pulls out a nasogastric tube. (See Table 25-7 for types of enteral feedings.)

In planning enteral feeding for a patient, first keep in mind the energy and protein need of the patient before selecting the formula needed. Next, consider whether the patient can tolerate a milk-based formula or if he requires lactose-free formula. Then determine if the patient can tolerate intact protein or if he requires a hydrolyzed source of protein. A blenderized feeding of regular foods may be available in hospitals, however, most now use selected commercial formulas (Table 25-7).

Most enteral feedings are started at ½ strength at 50 cc/hour. If tolerated, the rate can be increased by 25 cc/hour every 8-12 hours. Once the volume and rate have reached the desired level (usually 125 cc/hour/24 hours), the concentration can be increased to full strength (Table 25-8).

Infusion rates greater than 100-125 cc/hour of full-strength formula may not be tolerated by the patient, particularly the older patient. If volume must be limited because of problems with fluid overload, the formulas with greater caloric density are recommended (Table 25-7). If complications such as vomiting, gastric retention, or diarrhea occur, the feedings can be held and then restarted in 8-12 hours. Reglan can be added to stimulate peristalsis. Kaopectate or paregoric can be added for intractable diarrhea. Hyperglycemia can be treated with an oral hypoglycemic agent.[7]

For the patient who cannot digest food, who needs

Table 25-6 Types of Oral Feedings

1. Regular diet with modifications in nutrients or consistency as needed:
   - Diabetic
   - Weight-reduction
   - Fat-controlled (including cholesterol, type hyperlipidemia diets)
   - Protein-controlled
   - High-fiber or residue
   - Low-fiber or residue
   - Soft or edentulous
   - Pureed
   - Salt-controlled (500 mg to 4000 mg)
   - Potassium-controlled
   - No gastric stimulant
   - No cardiac stimulant
   - Combinations of above
2. Liquid Diets
   a. Clear—includes juice, broth, gelatin, tea, coffee
   b. Full—includes clear liquids plus milk products, strained soups
   c. Supplements (all low residue):

(1) Non-milk-based	*Ensure, Ensure Plus, Ensure HN *Travasorb *Precision (regular and high-nitrogen) Sustacal (regular and high-calorie) Isocal Magnacal
(2) Milk-based	Carnation Instant Breakfast Meritene
(3) Modular protein	*Casec (powder) *Promix (powder) *Propac (powder)
(4) Modular carbohydrate	*Cal Power (liquid) *Controlyte (powder) *Moducal *Polycose *Sumacal (regular and plus)
(5) Modular lipid	*Lipomul-Oral *MCT oil *Microlipid
(6) Hydrolyzed protein	Vivonex (standard and high-nitrogen) Criticare HN Vivonex Travasorb (standard and high-nitrogen)
(7) Special formula supplements	
(a) Renal disease	Amin-Aid Travasorb Renal
(b) Hepatic disease	Hepatic Aid Travasorb Hepatic
(c) Hypercatabolism	Trauma-Aid HN TraumaCal

*Lactose-free

Table 25-7 Types of Enteral Feedings

Type	kcal/cc
Blenderized	Depends on foods used
Non-milk-based, intact protein, residue-free	Avg. 0.8-1.0
Ensure	1.06
Ensure Plus (1)	1.5
Enrich (2)	1.06
Isocal	1.04
Isocal HCN (1)	2.0
Magnacal (1)	2.0
Nutri-1000 LF	1.06
Osmolite	1.06
Precision Isotonic	0.06
Precision LR (1)	1.11
Precision High Nitrogen (1)	1.05
Precision Isotein HN (1)	1.2
Sustacal	1.0
Sustacal HC	1.5
Travasorb	1.06
Travasorb MCT (1)	1.0
Milk-based intact protein, residue-free	
Nutri-1000	1.06
Meritene (1)	1.0
Blenderized, commercial, not residue-free	
Compleat-B	1.07
Formula 2	1.0
Vitaneed	1.02
Hydrolyzed protein, residue-free	
Criticare (1)	1.06
Nutramigen (1)	0.68
Travasorb STD (1)	1.0
Travasorb HN (1)	1.0
Vipep	1.0
Vital HN (1)	1.0
Vivonex Standard (1)	1.0
Vivonex HN (1)	1.0
Special purpose formulas, residue-free	
Amin-Aid (essential amino acids and histidine)	1.95
Hepatic Aid (high ratio BCAA to AAA)	1.1

(1) High osmolality at standard dilution; caloric density greater than 1.2 kcal/cc should be used with caution in a tube feeding

(2) New product with added fiber

Adapted from Zeman, F.J.: *Clinical Nutrition and Dietetics.* Lexington, Mass.: Collamore Press, 1983.

Table 25-8 Progression of Enteral Feedings

Concentration	Rate Per Hour	Comments Using 1.0 kcal/cc formula, patient receives:
Initial ½ strength	50 cc	600 kcal in 1200 cc
Progression ½ strength	125 cc	1500 kcal in 3000 cc
Full strength	125 cc	3000 kcal in 3000 cc

Adapted from Gray, D.S., and Kaminski, M.V.: "Nutrition Support of the Hospitalized Patient." *American Family Physician,* 28(3):143-150, 1983.

Table 25-9 Indications for Parenteral Nutrition

Unavailability of the gastrointestinal tract
- Short-bowel syndrome
- Obstruction
- Ileus
- Malabsorption
- Chronic vomiting

To minimize gastrointestinal function
- Inflammatory bowel disease
- Fistulas
- Intractable diarrhea and failure to thrive
- Acute pancreatitis

Preoperative repletion of patients who have lost more than 10-15% body weight

Patients who cannot meet energy needs by oral intake
- Hypermetabolism: major surgery or trauma, major burns, or sepsis
- Protein-losing gastroenteropathy
- Extreme weakness
- Anorexia and unwillingness to eat: cancer, chemotherapy, radiotherapy, psychological depression, or anorexia nervosa

Disturbances of nitrogen metabolism
- Reversible liver failure
- Acute and chronic renal failure

Nonterminal coma

Adapted from Zeman, F.J.: Clinical Nutrition and Dietetics. Lexington, Mass.: Collamore Press, 1983.

pancreatic or bowel rest, or who has a jejunostomy, the formulas composed of hydrolyzed protein or amino acids (elemental or chemically defined diets) are the feedings of choice (Table 25-7). Progression is similar to other enteral feedings. The greater osmolality of these feedings must be kept in mind; osmotic diarrhea and subsequent dehydration must be prevented.

The foregoing discussion has assumed drip feedings via gravity or infusion pump. Drip feedings via pump do ensure a constant, reliable flow. As an alterntive, however, patients may receive bolus feedings every two hours using an Asepto syringe. Although this method is time-consuming, patients may learn to feed themselves. (See Module 15, Nutritional Care of Deteriorating Patients, for specifics of feeding.)

Parenteral Nutrition

If your patient cannot tolerate oral or enteral feedings or cannot obtain adequate nutrition by these routes, parental nutrition may be your best alternative. An algorithm to assist you in deciding appropriate nutrition support methods is included in Appendix I.

Table 25-9 provides a list of patient problems for which parenteral nutrition is indicated. The products available for parenteral feeding are identified in Table 25-10.

If the patient is fairly well nourished yet needs parenteral support for a limited time, peripheral parenteral nutrition may be selected. Peripheral feeding is beneficial if central feeding is not needed or is contraindicated. It may provide amino acids alone or in combination with dextrose. If greater calories are needed, lipid can be infused peripherally, using a Y-connector. Different physicians have varying opinions on the benefits of amino acids alone (protein-sparing therapy) and the use of lipid as the primary energy source. Patients receiving lipid must be able to handle a high fluid load and be able to clear the lipid from circulation. Lipid is also very costly.

The method of parenteral feeding which can provide the most nourishment per volume is central venous feeding. It carries the risk, however, of catheter insertion and sepsis, but these risks are minimized with a well-defined protocol.

Central venous nutrition consists of giving 4.25-10% amino acids, 15-35% dextrose with appropriate electrolytes, vitamins, and minerals, with 2-3 liters infused in 24 hours. Lipid (500 ml) is typically given 2-3 times a week through a Y-connector to prevent essential fatty acid deficiency (Table 25-11). The amount of lipid can be increased and dextrose decreased if fluid overload is a concern or if the patient has pulmonary insufficiency.

Complications of central venous hyperalimentation include electrolyte imbalances, which are easily monitored and corrected by adjusting the electrolytes in the solution. Insulin can be added to the solution if hyperglycemia develops. The addition of vitamins, minerals, and trace minerals is essential to prevent nutrition deficiencies.

Table 25-10 Products Available for Parenteral Nutrition

	Peripheral Line	Central Venous Line
Crystalline amino acids with vitamins and minerals	4.25%	4.25%
Aminosyn Freamine II Nephromine (EAA) Travasol Veinomine		
Dextrose	5-10%	15-35%
Lipid	10-20%	10-20%
Intralipid Liposyn Travamulsion		

Table 25-11 Typical TPN Solution

Amino Acids	8.5%	$MgSO_4$	8 mEq
Dextrose	50%	Ca Gluconate	10 mEq
NaC1	50 mEq	MVI-12	10 ml
Na Acetate	30 mEq	Zinc	4 mg
KC1	30 mEq	Copper	1 mg
K_2PO_4	10 mM		

Weekly Vit K IM 2-5 mg

Final Concentration
Dextrose 25%
Amino acids 4.25%

With 500 ml lipid twice weekly (450 kcal/500 ml)

Nonprotein calories
850 kcal/liter carbohydrate
130 kcal/day (average) lipid

Nitrogen 7.1 g/liter

Table 25-12 Typical TPN Progression Regimen

Day	Solution Infusion Rate (ml/hr)	Total Infusion (ml/day)	kcal Infusion (kcal/day)	Nitrogen Intake (gm/day)
1	50	1200	890	8.4
2	75	1800	1335	12.6
3	125	3000	2225	21.0

Patients are usually started on the typical TPN solution (Table 25-11) at 50 ml/hr for 24 hours. This can often be increased to a maximum rate of 125 ml/hr by the third day (Table 25-12).

This regimen provides a non-protein calorie-to-nitrogen ratio of approximately 112:1, which approximates the ratio of 120:1 recommended for protein-sparing activity.

Special amino acid formulas are available for patients with renal disease; they supply only the essential amino acids. Use of a 1.25% standard amino acid formula may also be satisfactory.

A current controversy exists over the use of branched-chain amino acids (leucine, isoleucine, and valine) in glucose-intolerant, hypermetabolic patients. In stress and infection, branched-chain amino acids are released by muscle at increased rates for use as an energy source. Feeding these amino acids along with glucose has been shown to preserve lean body mass.

When the ratio of branched-chain amino acids to aromatic amino acids decreases, the aromatic amino acids are taken up by the brain of the patients with liver failure and may contribute to hepatic encephalopathy. Use of branched-chain amino acids may reverse this, but this has not been well demonstrated.

Patients should be weaned off TPN when the other forms of nutrition support become adequate. Infusion rate should be decreased to 50 ml/hr over several days and then stopped. It should be remembered that patients may have gut atrophy when the gut has not been used. Assess this function when stopping TPN.

Problems in atrophy include a decrease in intestinal mass and digestive enzymes, as well as some decrease in metabolic rate, thyroid hormone, and catecholamine concentrations. Diarrhea or vomiting may ensue if refeeding is too rapid. Refeeding should begin with liquids; if liquids are tolerated, solids should be begun in approximately 48 hours.

Home parenteral nutrition is an option for patients for whom TPN must provide the sole means of nutrition

support. Before the advent of home TPN, patients who were stable were sent home on an oral or enteral program which ultimately failed; readmission was frequent for dehydration and malnutrition.[16] A carefully devised program is now possible whereby patients can administer their own infusions over a 12 to 16-hour period. This "cyclic TPN" requires that patients be able to tolerate infusion rates of 150-200 cc/hour (170 cc for 12-14 hours, decreasing to 50 cc the last 2 hours). Patients must be capable of mixing their own solutions or, if a pharmacy is available for the mixing, to do catheter care, connect and disconnect the tubing and bags, and regulate the infusion pump.

The psychological and social benefits of home TPN are immeasurable. Hospital readmissions are reduced with home TPN, and the cost benefits are great. It has been well-documented that TPN promotes weight gain, positive nitrogen balance, wound healing, general reduction of morbidity, and thus improvement of hospital and home nutrition.[17]

Patients learn self-care and can return to normal life styles.[16] In addition, third-party reimbursement for TPN is often available. For physicians desiring more in-depth discussion of TPN, the resource list contains several references.

Recommendations for Management of Nutrition after Hospital Discharge

In order for your patients to continue rehabilitation after discharge, you need an understanding of the setting into which they are moving, facilities in that setting to allow recovery, and resources in the community to facilitate recovery and maintenance of health care. You also need to teach how to utilize available resources and nutritional therapies, and how to avoid undesirable therapies once patients are on their own.

Assuming you have prepared the patient for discharge, it is time to plan your strategy to assure that rehabilitation will continue in the ambulatory setting. Some key questions you should be asking include:

1. Where is the patient going following discharge?
2. Will there be self-care or other home health care providers?
3. Does the patient have adequate resources (time and money) to continue the treatment plan?
4. Who will be procuring and preparing foods in the home setting?
5. Is the patient emotionally and physically capable of following treatment and/or wellness strategies?
6. What can the patient expect in terms of future risks to health maintenance?
7. What resources in the community exist to which the patient can be directed for continuation of the health care plan?

When discharging patients from hospital to home, it is important to consider a home nutrition care plan. Was your patient malnourished prior to admission, did your patient have aberrant eating practices prior to admission or during hospitalization, or did the patient become malnourished as a result of treatment? Remember that without counseling, the patient, in all liklihood, will return to pre-admission practices. Therefore, the registered dietitian needs to be a part of the team preparing the patient for discharge. Optimally, this nutrition specialist should have been involved with the patient and family during the entire hospital stay since nutrition intervention and counseling take a period of time. The discharge diet order should also be devised with other treatments in mind, remembering that interactions of nutrition and drugs, chemotherapy, and radiation therapy do not stop with hospital discharge!

Patients given last-minute diet counseling or other instructions are typically preoccupied with discharge and may assimilate little of what was said. Maximal learning about a "new eating lifestyle" occurs with multiple teaching sessions to permit (1) full understanding on the part of the patient and significant others, and (2) use of various motivational techniques to maximize compliance. Thus, most of the learning will occur in the ambulatory setting of your office.

Patients who qualify may receive government-sponsored health care through organizations such as Visiting Nurse Services.

If home-care providers (family, friends, etc.) are not available, you may suggest that a commercial home-health-care agency be employed until the patient can resume self-care. Nursing homes and other extended care facilities are an option if the patient needs total or partial care.

Meals on Wheels or other government- or philanthropic-sponsored community feeding sites may be

recommended for patients who are unable to procure or prepare foods at home.

A growing method of care for the terminally ill is hospice care. The nutrition-related goals of this association are to

1. promote enjoyment in eating, and
2. help the patient and family place appropriate importance on food and eating.

Whatever the setting to which the patient goes, nutrition follow-up is essential. Dietitians in ambulatory care settings and in private practice are available for follow-up care. Your monitoring of the major nutrition parameters is crucial to the ongoing prevention of nutrition-related problems at home.

Summary

In summary, preventing home and hospital malnutrition will contribute to the goal of improved health care outcomes. The process of providing quality health care includes a sound nutrition plan. Assessing nutritional status, developing a plan, and providing the means for implementing the plan will help assure good nutrition status. Good nutrition can decrease hospital readmissions, and thus lower hospital costs.

Evaluation

The purpose of this evaluative exercise is to assist you in organizing the information and resources you may need in planning for hospital or home care of your patients. Please answer the question asked and then discuss your responses with other residents, faculty, and if possible, available nutrition specialists.

1. What information regarding a patient's nutrition status should be obtained at the time of admission?

2. Is there a nutrition specialist available who can assist you as you:

   A. Assess the nutrition status of your patient?

   _____Yes _____No

   B. Plan an appropriate diet during your patient's hospital stay?

   Yes_____ No_____

   Name_____ Phone_____

   B. Plan an appropriate diet during your patient's hospital stay?

   Yes_____ No_____

   Name_____ Phone_____

   C. Plan an appropriate diet for home care and recuperation?

   Yes_____ No_____

   Name_____ Phone_____

   D. Plan appropriate nutrition treatment for a patient who is left nutritionally compromised?

   Yes_____ No_____

   Name_____ Phone_____

3. What resources are available to:

   A. Provide meals for patients at home who cannot easily cook for themselves?

   B. Provide ongoing nutrition counseling for patients with chronically compromised nutrition status?

   C. Assist in finding funds for patients who do not have the funds necessary to maintain an appropriate diet?

4. Select one of your patients who is about to be hospitalized. Using the Patient Assessment Worksheet (Appendix E), assess the patient's nutrition status. Prepare a nutrition prescription for the patient which includes pre-admission considerations, hospital-care considerations, and home-care or recuperative considerations.

5. If your practice does not now have a protocol for the nutrition assessment and care of hospitalized and home-care patients, work with other residents, faculty, and available nutrition specialists to develop such a protocol. Use this module as a guide in preparing this document.

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Resources for the Physician

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Patient Handout
Resources for the Physician and Patient

Nutritional Management of Dumping Syndrome

Individualize the diet to the patient's tolerance. Consult the patient frequently concerning his/her response to individual food items and to portion sizes. The following items are general guidelines:

Reduce intake of carbohydrates to 100-200 gm/day. Avoid simple sugars to prevent rapid movement of food into the jejunum with formation of hyperosmolar solution. Use unsweetened fruits.

Increase fat content to 30-40% of calories to slow stomach emptying and to provide sufficient calories for weight gain.

Increase protein to 20% of calories for tissue formation and to supply energy. Include some protein in each meal.

Meals should be frequent, low in bulk, and dry. Six or more meals per day is wise. Increase portion sizes as the patient's tolerance increases.

Provide low-carbohydrate fluids between meals, no sooner than 1-2 hours after or before a meal, to slow gastric emptying. Avoid high-carbohydrate fluids.

All food and drink should be moderate in temperature. Cold drinks, especially, cause increased gastric motility.

Avoid stress, eat slowly, and then lie down for 20-30 minutes after eating.

Eat a variety of foods to provide an adequate diet and to promote achievement of ideal body weight. Try foods that were being avoided preoperatively.

The possibility of lactose intolerance exists. Milk should be avoided until it is established that it can be tolerated.

To progress toward a more normal intake, add moderate amounts of carbohydrate with caution if no symptoms of dumping occur in the first several days. Use sugar only in the form of sweetened fruits, fruit juices, and desserts, such as sponge cake and cookies. If these are well tolerated, more concentrated carbohydrates and foods at temperature extremes can be added. Fresh fruits and vegetables may be added in 2-3 weeks; they should be chewed thoroughly.

Adapted from Zeman, F.J.: *Clinical Nutrition and Dietetics.* Lexington, Massachusetts: Collamore Press, 1983.

Appendix A-1

Formulas for Estimating Body Weight and Body Composition

Calculating ideal body weight (express in range ± 10%):

Males — 106 lb for first 5 feet; add 6 lb for each additional inch over 5 feet.

Females — 100 lb for first 5 feet; add 5 lb for each additional inch over 5 feet.

Calculating percent of ideal body weight:

$$\% \text{ IBW} = \left[\frac{\text{actual weight}}{\text{ideal weight}}\right] \times 100$$

Calculating weight changes:

$$\% \text{ weight change} = \left[\frac{\text{usual weight} - \text{current weight}}{\text{usual weight}}\right] \times 100$$

Calculating percent body fat:

Technique: Skinfold caliper measurements of triceps, subscapular

Standards: see Appendices A-2,3,4, and Module 2, Appraisal of Nutritional Status

Calculating arm muscle circumference:

Technique:

Arm muscle circumference (cm) = Mid-arm circumference (cm) – [0.314 x triceps skinfold (mm)]

Standards: see Appendices A-2,3

Calculating nitrogen balance:

$$\left[\frac{\text{Protein intake (gm)}}{\text{N balance (gm)} = 6.25 \text{ gm protein/gm nitrogen}}\right] - [\text{UUN (in gm nitrogen)} + 4 \text{ gm nitrogen loss in feces, skin, hair, etc.}]$$

Calculating Creatinine-Height Index (CHI):

Technique:

$$\% \text{ deficit in CHI} = 100 - \left[\frac{\text{actual urinary creatinine}}{\text{ideal urinary creatinine}}\right] \times 100$$

Standards: See Appendices A-4 and B

Appendix A-2

Percentiles for Upper Arm Diameter and Upper Arm Circumferences for Whites of the Ten-State Nutrition Survey of 1968-1970

Age midpoint, years*	Arm Muscle-Right Arm diameter percentiles, mm					circumference percentiles, mm				
	5th	15th	50th	85th	95th	5th	15th	50th	85th	95th
Males										
0.3	26	30	34	40	42	81	94	106	125	133
1	32	34	39	44	46	100	108	123	137	146
2	35	37	40	44	46	111	117	127	138	146
3	36	38	42	46	48	114	121	132	145	152
4	38	39	43	48	50	118	124	135	151	157
5	39	41	45	50	53	121	130	141	156	166
6	40	43	47	51	53	127	134	146	159	167
7	41	43	48	52	55	130	137	151	164	173
8	44	46	50	55	59	138	144	158	174	185
9	44	46	51	58	64	138	143	161	182	200
10	45	48	53	59	64	142	152	168	186	202
11	48	50	55	62	67	150	158	174	194	211
12	49	52	58	66	70	153	163	181	207	221
13	51	54	62	71	77	159	169	195	224	242
14	53	58	67	74	84	167	182	211	234	265
15	55	59	70	80	86	173	185	220	252	271
16	59	65	73	83	89	186	205	229	260	281
17	66	69	78	86	92	206	217	245	271	290
21	69	74	82	91	97	217	232	258	286	305
30	70	77	86	94	100	220	241	270	295	315
40	71	76	86	96	101	222	239	270	300	318
Females										
0.3	27	29	33	37	40	86	92	104	115	126
1	31	32	37	41	43	97	102	117	128	135
2	34	36	40	44	46	105	112	125	140	146
3	34	37	41	44	46	108	116	128	138	143
4	36	38	42	46	48	114	120	132	146	152
5	38	40	44	48	51	119	124	138	151	160
6	38	41	45	49	53	121	129	140	155	165
7	39	42	47	52	56	123	132	146	162	175
8	41	44	48	53	59	129	138	151	168	186
9	43	45	50	56	62	136	143	157	176	193
10	44	47	52	58	62	139	147	163	182	196
11	44	48	55	62	67	140	152	171	195	209
12	48	51	57	64	68	150	161	179	200	212
13	49	53	59	66	71	155	165	185	206	225
14	53	56	61	70	74	166	175	193	221	234
15	52	55	62	70	74	163	173	195	220	232
16	54	47	64	72	83	171	178	200	227	260
17	54	56	62	71	77	171	177	196	223	241
21	54	58	65	73	80	170	183	205	229	253
30	56	60	68	78	87	177	189	213	245	272
40	57	61	69	80	89	180	192	216	250	279

From U.S. Department of Health, Education, and Welfare: "Ten-State Nutrition Survey, 1968-1970." DHEW Publication No. (H.M.S.) 72-8130 — 72-8134, 1972.

Appendix A-3

Arm-Muscle Circumference

Poor muscle development and muscle wasting are cardinal features of all forms of protein-calorie malnutrition, especially those of early childhood. In older children and adults, muscle mass is also related to general exercise and to special increased use of certain muscle groups. Although muscle mass can be assessed by various methods (body radioactive potassium and 24-hour creatinine excretion), the most practical field method of assessing muscle mass is the direct physical anthropometry of a limb.

Technique

The mid-upper-arm circumference is the most useful and accessible measurement site. The upper arm is generally not clinically edematous in the malnourished individual.

The arm measured should be the same as the one chosen for skinfold measurements and the standard chosen for comparison. The example in this module is performed on the right arm (figure at right).

The right arm is measured at its midpoint, which is selected in the same way as for the triceps skinfold and Figure 2-4, Module 2. A metric flexible steel or fiberglass tape is recommended. The tape is placed gently, but firmly, around the arm which is hanging freely at the subject's side to avoid compression of the soft tissue (figure at right). The measurement is read to the nearest 0.1 cm. Next, the overlying subcutaneous fat is measured in the triceps region with skinfold calipers as described in Appendix A, Module 2.

Measurement of Mid-Upper-Arm Circumference

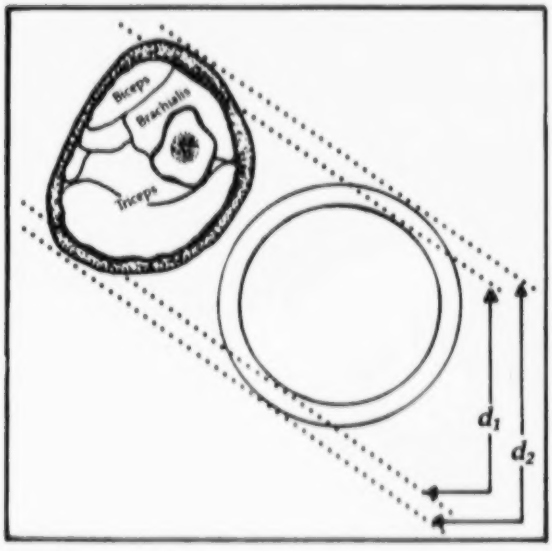
Conversions

From these 2 measurements, it is possible to calculate the inner circle, which is composed principally of muscle, with a small central core of bone. It is usually assumed that the bone is relatively constant in size, and the calculated value is termed the "mid-arm circumference." The formula for the calculation of the mid-arm-muscle circumference (below) relates well with the more general manifestations of protein-calorie malnutrition. Also, it is an attempt to assess a body-wide tissue by a measurement at a single site, which may be affected unequally in different muscle groups. Nevertheless, the arm-muscle circumference does represent a practical gauge of muscle tissue that can be easily obtained. (See figure on next page.)

Arm-Muscle Circumference Formula

$$\underset{(cm)}{\text{Arm muscle circumference}} = \underset{(cm)}{\text{Mid-Arm Circumference}} - \left[0.314 \times \underset{(mm)}{\text{Triceps Skinfold}}\right]$$

Calculation of Mid-Upper-Arm-Muscle Circumference



C_1 = arm circumference
S = triceps skin-fold
d_1 = arm diameter
d_2 = muscle diameter

Then skin-fold $S = 2 \times$ subcutaneous fat $= d_1 - d_2$
and arm circumference $C_1 = \pi d_1$
Now, muscle circumference $C_2 =$
$\pi d2 = \pi [d_1 - (d_1 - d_2)] = \pi d_1 - \pi(d_1 - d_2)$.
Hence, $C_2 = C_1 - \pi S$.

Example

Mr. H., 62 years old, has chronic emphysema and is dependent on daily oxygen use. He states his appetite is poor and he often tires before finishing his meals. He has 2 + pedal edema due to congestive heart failure. Therefore, it is difficult to evaluate his weight status.

Values

Mid-Arm Circumference	= 26.0 cm, or 260 mm
Triceps Skinfold	= 10.8 mm
AMC	= 26.0 – (0.314 x 10.8) = 26.0 – 3.3912 = 22.61 cm or 226.1 mm

In comparing Mr. H.'s triceps skinfold of 10.8 mm with the standards in Table 2-10 in module 2, we find him between the 50th and 60th percentile for his age group. His arm-muscle circumference of 226.1 millimeters, when compared with the standards in Appendix A-2, places him between the 5th and 15th percentile for age group 40 standard. Values for age 41 and above are not available. If available, these measurements would most likely indicate that Mr. H. is depleted of lean body tissue (muscle mass), as well as somewhat marginal for fat stores. Aggressive nutritional intervention would be indicated before his situation deteriorates further.

Appendix A-4

Ideal Weight and Urinary Creatinine for Height

For Women

Height	Medium Frame Ideal Weight		Total Mg Creatinine 24 hours	Mg Creatinine/ Cm Body Height/ 24 hours
4'10" 147.3 Cm	101.5 Lbs	46.1 Kg	830	5.63
4'11" 149.9	104	47.3	851	5.68
5' 0 152.4	107	48.6	875	5.74
5' 1" 154.9	110	50	900	5.81
5' 2" 157.5	113	51.4	925	5.87
5' 3" 160	116	52.7	949	5.93
5' 4" 162.6	119.5	54.3	977	6.01
5' 5" 165.1	123	55.9	1006	6.09
5' 6" 167.6	127.5	58	1044	6.23
5' 7" 170.2	131.5	59.8	1076	6.32
5' 8" 172.7	135.5	61.6	1109	6.42
5' 9" 175.3	139.5	63.4	1141	6.51
5'10" 177.8	143.5	65.2	1174	6.60
5'11" 180.3	147.5	67	1206	6.69
6' 0" 182.9	151.5	68.9	1240	6.78
For Men				
5' 2" 157.5 Cm	124 Lbs	56 Kg	1288	8.17
5' 3" 160	127	57.6	1325	8.28
5' 4" 162.6	130	59.1	1359	8.36
5' 5" 165.1	133	60.3	1386	8.40
5' 6" 167.6	137	62	1426	8.51
5' 7" 170.2	141	63.8	1467	8.62
5' 8" 172.7	145	65.8	1513	8.76
5' 9" 175.3	149	67.6	1555	8.86
5'10" 177.8	153	69.4	1596	8.98
5'11" 180.3	158	71.4	1642	9.11
6' 0" 182.9	162	73.5	1691	9.24
6' 1" 185.4	167	75.6	1739	9.38
6' 2" 188	171	77.6	1785	9.49
6' 3" 190.5	176	79.6	1831	9.61
6' 4" 193	181	82.2	1891	9.80

Somatic Proteins % Deficit		
Severe	Moderate	Mild
>30	>15-30	>5-15

From Kaminski, M.V. and Winborn, A.L.: *Nutritional Assessment Guide*. Chicago, Midwest Nutrition, Education, and Research Foundation, Inc., 1978. Used with permission of Midwest Nutrition, Education, and Research Foundation, Inc., © 1978, Chicago, IL.

Appendix B

Criteria for Evaluation of Protein Status

	Normal	Moderate Deficit	Severe Deficit
Visceral Proteins			
Albumin (g/dl)	3.5-5.0	2.8-3.2	< 2.8
Prealbumin (mg/dl)	30-50	20-30	< 15
Retinol binding protein (μg/ml)	40-50	25-40	20-25
Lymphycytes (per mm^3)	> 1500	800-1200	< 800
Transferrin (mg/dl)	> 200	160-180	< 160
TIBC (μg g/dl)	> 214	152-182	< 152
Somatic Proteins			
Arm-muscle circumference (AMC) % of std	> 90	70-80	< 70
Creatinine Height Index (CHI) % of std	> 90	71-80	60-80
Delayed hypersensitivity testing			
	Competence	Moderate Deficit	Anergy
Induration in 3 tests after 48 hours-mumps, Candida, SK/SD (mm)	> 10	5-10	< 5

Adapted from Zeman, F.J.: *Clinical Nutrition and Dietetics.* Lexington, Massachusetts: Collamore Press, 1983.

Appendix C

ANERGIC METABOLIC PROFILE

Patient _____ Room _____

Date _____

	Parameters	Value	Deficit: Severe	Mod	Mild	Adequate
Marasmus	**Somatic proteins**					
	Weight/height					
	Triceps skinfold (mm)					
	Arm-muscle circumference (cm)					
	Creatinine/height index					
Kwashiorkor	**Visceral proteins**					
	Serum albumin (g/dL)					
	Serum transferrin (mg/dL)					
	Total lymphocyte count (per mm^3)					
	Cell-mediated immunity					

Nitrogen in (g/day) ____

Nitrogen out (g/day) ____

Nitrogen balance (g/day) ☐

Nutritional status	**Degree**
☐ Adequate	☐ None
☐ Marasmus	☐ Mild
☐ Kwashiorkor	☐ Moderate
☐ Marasmic kwashiorkor	☐ Severe

Standards	Severe	Moderate	Mild
Somatic proteins (% deficit)	> 30%	> 15-30%	> 5-15%
Serum albumin (g/dL)	< 2.5	< 3.0-2.5	< 3.5-3.0
Serum transferrin (mg/dL)	< 160	< 180-160	< 200-180
Total lymphocyte count (per mm^3)	< 900	< 1,500-900	< 1,800-1,500
Cell-mediated immunity (mm)	< 5-0	< 10-5	< 15-10

Adpated from Gray, D.S., and Kaminski, M.V.: "Nutrition Support of the Hospitalized Patient." *American Family Physician*, 28(3):143-150, 1983.

Appendix D

Guide to Good Eating

Milk Group

Calcium
Riboflavin (B_2)
Protein

2 Servings/Adults
4 Servings/Teenagers
3 Servings/Children

Foods made from milk contribute part of the nutrients supplied by a serving of milk.

Meat Group

Protein
Niacin
Iron
Thiamin (B_1)

2 Servings

Dry beans and peas, soy extenders, and nuts combined with animal protein (meat, fish, poultry, eggs, milk, cheese) or grain protein can be substituted for a serving of meat.

Fruit-Vegetable Group

Vitamins A and C

4 Servings

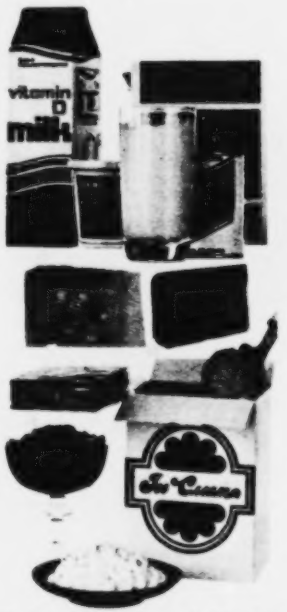
Dark green, leafy, or orange vegetables and fruit are recommended 3 or 4 times weekly for vitamin A. Citrus fruit is recommended daily for vitamin C.

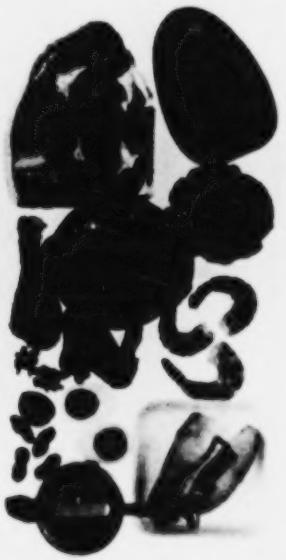
Grain Group

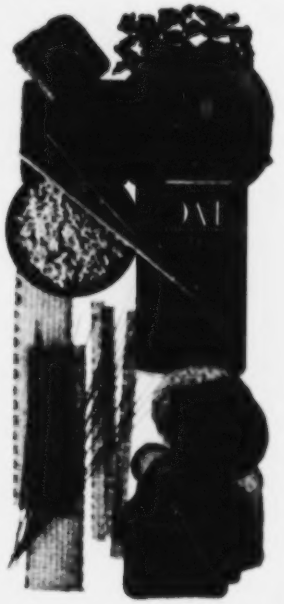
Carbohydrate
Thiamin (B_1)
Iron
Niacin

4 Servings

Whole grain, fortified, or enriched grain products are recommended.







Foods and condiments, such as these, complement but do not replace foods from the four groups.

Amounts should be determined by individual caloric needs.

Others

Carbohydrate
Fats

Guide to Good Eating

A Recommended Daily Pattern

Guide to Good Eating...

A Recommended Daily Pattern

The recommended daily pattern provides the foundation for a nutritious, healthful diet.

The recommended servings from the Four Food Groups for adults supply about 1200 Calories. The chart below gives recommendations for the number and size of servings for several categories of people.

Food Group	Recommended Number of Servings				
	Child	Teenager	Adult	Pregnant Woman	Lactating Woman
Milk 1 cup milk, yogurt, OR **Calcium Equivalent** 1½ slices (1½ oz) cheddar cheese* 1 cup pudding 1½ cups ice cream 2 cups cottage cheese*	3	4	2	4	4
Meat 2 ounces cooked, lean meat, fish, poultry, OR **Protein Equivalent** 2 eggs 2 slices (2 oz) cheddar cheese* ½ cup cottage cheese* 1 cup dried beans, peas 4 tbsp peanut butter	2	2	2	3	2
Fruit-Vegetable ½ cup cooked or juice 1 cup raw Portion containing served such as a medium-size apple or banana	4	4	4	4	4
Grain, whole grain, fortified, enriched 1 slice bread 1 cup ready-to-eat cereal ½ cup cooked cereal, grits	4	4	4	4	4

*Does not apply if serving of milk OR meat not both omitted/eaten.

Where completion for 4 or more foods from the Four Food Group Amounts should be determined by individual within foods

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Nutrients for Health

Nutrients are chemical substances obtained from foods during digestion. They are needed to build and maintain body cells, regulate body processes, and supply energy.

About 50 nutrients, including water, are needed daily for optimum health. If one obtains the proper amount of the 10 "leader" nutrients in the daily diet, the other 40 or so nutrients will likely be consumed in amounts sufficient to meet body needs.

One's diet should include a variety of foods because no single food supplies all the 50 nutrients, and because many nutrients work together.

When a nutrient is added or a nutritional claim is made, nutrition labeling regulations require listing the 10 leader nutrients on food packages. These nutrients appear in the chart below with food sources and some major physiological functions.

Nutrient	Important Sources of Nutrient	Some major physiological functions		
		Provide energy.	Build and maintain body cells.	Regulate body processes.
Protein	Meat, Poultry, Fish Dried Beans and Peas Egg Cheese Milk	Supplies 4 Calories per gram.	Constitutes part of the structure of every cell, such as muscle, blood, and bone; supports growth and maintains healthy body cells.	Constitutes part of enzymes, some hormones and body fluids, and antibodies that increase resistance to infection.
Carbohydrate	Cereal Potatoes Dried Beans Corn Bread Sugar	Supplies 4 Calories per gram. Major source of energy for central nervous system.	Supplies energy so protein can be used for growth and maintenance of body cells.	Unrefined products supply fiber – complex carbohydrates in fruits, vegetables, and whole grains – for regular elimination. Assists in fat utilization.
Fat	Shortening, Oil Butter, Margarine Salad Dressing Sausages	Supplies 9 Calories per gram.	Constitutes part of the structure of every cell. Supplies essential fatty acids.	Provides and carries fat-soluble vitamins (A, D, E, and K).
Vitamin A (Retinol)	Liver Carrots Sweet Potatoes Greens Butter, Margarine		Assists formation and maintenance of skin and mucous membranes that line body cavities and tracts, such as nasal passages and intestinal tract, thus increasing resistance to infection.	Functions in visual processes and forms visual purple, thus promoting healthy eye tissues and eye adaptation in dim light.
Vitamin C (Ascorbic Acid)	Broccoli Orange Grapefruit Papaya Mango Strawberries		Forms cementing substances, such as collagen, that hold body cells together, thus strengthening blood vessels, hastening healing of wounds and bones, and increasing resistance to infection.	Aids utilization of iron.
Thiamin (B_1)	Lean Pork Nuts Fortified Cereal Products	Aids in utilization of energy.		Functions as part of a coenzyme to promote the utilization of carbohydrate. Promotes normal appetite. Contributes to normal functioning of nervous system.
Riboflavin (B_2)	Liver Milk Yogurt Cottage Cheese	Aids in utilization of energy.		Functions as part of a coenzyme in the production of energy within body cells. Promotes healthy skin, eyes, and clear vision.
Niacin	Liver Meat, Poultry, Fish Peanuts Fortified Cereal Products	Aids in utilization of energy.		Functions as part of a coenzyme in fat synthesis, tissue respiration, and utilization of carbohydrate. Promotes healthy skin, nerves, and digestive tract. Aids digestion and fosters normal appetite.
Calcium	Milk, Yogurt Cheese Sardines and Salmon with Bones Collard, Kale, Mustard, and Turnip Greens		Combines with other minerals within a protein framework to give structure and strength to bones and teeth.	Assists in blood clotting. Functions in normal muscle contraction and relaxation, and normal nerve transmission.
Iron	Enriched Farina Prune Juice Liver Dried Beans and Peas Red Meat	Aids in utilization of energy.	Combines with protein to form hemoglobin, the red substance in blood that carries oxygen to and carbon dioxide from the cells. Prevents nutritional anemia and its accompanying fatigue; increases resistance to infection.	Functions as part of enzymes involved in tissue respiration.

From National Dairy Council: *A Guide to Good Eating*, 4th edition. Rosemont, Illinois, 1977. Used with permission of the National Dairy Council.

Appendix E

Patient Assessment Worksheet

Patient Name _____

Age _____ Height _____

Current Weight _____ Ideal Body Weight _____
(F: 100 lb for 5 feet
+ 5 lb for each additional inch)

Usual Weight _____ (M: 106 lb for 5 feet
+6 lb for each additional inch)

Weight Change:

$$\left[\frac{\text{usual weight} - \text{current weight}}{\text{usual weight}}\right] \times 100 = _____\%$$

Caloric Need:
ideal body weight x 10 kcal/lb to lose weight
ideal body weight x 15 kcal/lb to maintain weight
ideal body weight x 20 kcal/lb to gain weight

Protein Intake:	Intake:	
Meat, fish, poultry 7 gm/oz	_____ oz/day	_____ gm protein
Milk or cheese 8 gm/cup or 1 oz cheese	_____ c/day	_____ gm protein
Breads and starches 2 gm/slice or 1/2 cup	_____ slices/day	_____ gm protein
Fruits 0.5 gm/1/2 cup or piece	_____ pieces/day	_____ gm protein
		Daily Intake _____

Protein Need _____ vs usual intake _____

(0.7-1.0 gm/kg/day = resting need, healthy patient)
(1.2-1.5 gm/kg/day = malnourished patient need)
(1.5-2.0 gm/kg/day = severely stressed patient need)

Depressed visceral or somatic proteins _____

_____

Food and Nutrition Board, National Academy of Sciences – National Research Council Recommended Daily Dietary Allowances,[a] Revised 1980

Designed for the maintenance of good nutrition of practically all healthy people in the U.S.A.

	Age (years)	Weight (kg)	Weight (lb)	Height (cm)	Height (in)	Protein (g)	Fat-Soluble Vitamins: Vitamin A (μg RE)[b]	Fat-Soluble Vitamins: Vitamin D (μg)[c]	Fat-Soluble Vitamins: Vitamin E (mg α-TE)[d]	Water-Soluble Vitamins: Vitamin C (mg)	Water-Soluble Vitamins: Thiamin (mg)	Water-Soluble Vitamins: Riboflavin (mg)	Water-Soluble Vitamins: Niacin (mg NE)[e]	Water-Soluble Vitamins: Vitamin B-6 (mg)	Water-Soluble Vitamins: Folacin[f] (μg)	Water-Soluble Vitamins: Vitamin B-12 (μg)	Minerals: Calcium (mg)	Minerals: Phosphorus (mg)	Minerals: Magnesium (mg)	Minerals: Iron (mg)	Minerals: Zinc (mg)	Minerals: Iodine (μg)
Infants	0.0–0.5	6	13	60	24	kg × 2.2	420	10	3	35	0.3	0.4	6	0.3	30	0.3[g]	360	240	50	10	5	40
	0.5–1.0	9	20	71	28	kg × 2.0	400	10	4	35	0.5	0.6	8	0.6	45	1.5	540	360	70	15	5	50
Children	1–3	13	29	90	35	23	400	10	5	45	0.7	0.8	9	0.9	100	2.0	800	800	150	15	10	70
	4–6	20	44	112	44	30	500	10	6	45	0.9	1.0	11	1.3	200	2.5	800	800	200	10	10	90
	7–10	28	62	132	52	34	700	10	7	45	1.2	1.4	16	1.6	300	3.0	800	800	250	10	10	120
Males	11–14	45	99	157	62	45	1000	10	8	50	1.4	1.6	18	1.8	400	3.0	1200	1200	350	18	15	150
	15–18	66	145	176	69	56	1000	10	10	60	1.4	1.7	18	2.0	400	3.0	1200	1200	400	18	15	150
	19–22	70	154	177	70	56	1000	7.5	10	60	1.5	1.7	19	2.2	400	3.0	800	800	350	10	15	150
	23–50	70	154	178	70	56	1000	5	10	60	1.4	1.6	18	2.2	400	3.0	800	800	350	10	15	150
	51+	70	154	178	70	56	1000	5	10	60	1.2	1.4	16	2.2	400	3.0	800	800	350	10	15	150
Females	11–14	46	101	157	62	46	800	10	8	50	1.1	1.3	15	1.8	400	3.0	1200	1200	300	18	15	150
	15–18	55	120	163	64	46	800	10	8	60	1.1	1.3	14	2.0	400	3.0	1200	1200	300	18	15	150
	19–22	55	120	163	64	44	800	7.5	8	60	1.1	1.3	14	2.0	400	3.0	800	800	300	18	15	150
	23–50	55	120	163	64	44	800	5	8	60	1.0	1.2	13	2.0	400	3.0	800	800	300	18	15	150
	51+	55	120	163	64	44	800	5	8	60	1.0	1.2	13	2.0	400	3.0	800	800	300	10	15	150
Pregnant						+30	+200	+5	+2	+20	+0.4	+0.3	+2	+0.6	+400	+1.0	+400	+400	+150	h	+5	+25
Lactating						+20	+400	+5	+3	+40	+0.5	+0.5	+5	+0.5	+100	+1.0	+400	+400	+150	h	+10	+50

[a] The allowances are intended to provide for individual variations among most normal persons as they live in the United States under usual environmental stresses. Diets should be based on a variety of common foods in order to provide other nutrients for which human requirements have been less well defined.

[b] Retinol equivalents. 1 retinol equivalent = 1 μg retinol or 6 μg β carotene.

[c] As cholecalciferol. 10 μg cholecalciferol = 400 IU of vitamin D.

[d] α-tocopherol equivalents. 1 mg *d*-α tocopherol = 1 α-TE.

[e] 1 NE (niacin equivalent) is equal to 1 mg of niacin or 60 mg of dietary tryptophan.

[f] The folacin allowances refer to dietary sources as determined by *Lactobacillus casei* assay after treatment with enzymes (conjugases) to make polyglutamyl forms of the vitamin available to the test organism.

[g] The recommended dietary allowance for vitamin B-12 in infants is based on average concentration of the vitamin in human milk. The allowances after weaning are based on energy intake (as recommended by the American Academy of Pediatrics) and consideration of other factors, such as intestinal absorption.

[h] The increased requirement during pregnancy cannot be met by the iron content of habitual American diets nor by the existing iron stores of many women; therefore the use of 30–60 mg of supplemental iron is recommended. Iron needs during lactation are not substantially different from those of nonpregnant women, but continued supplementation of the mother for 2–3 months after parturition is advisable in order to replenish stores depleted by pregnancy.

From *Recommended Dietary Allowances*, Ninth Edition (1980). Used with permission of the National Academy of Sciences, Washington, D.C.

*The tenth edition of *Recommended Dietary Allowances* will be available as of Fall, 1985.

Appendix G

Current Guidelines for Criteria of Nutritional Status for Laboratory Evaluation

Nutrient and Units	Age of Subject (years)	Criteria of Status		
		Deficient	Marginal	Acceptable
*Hemoglobin (gm/100ml)	6-23 mos.	Up to 9.0	9.0- 9.9	10.0+
	2-5	Up to 10.0	10.0-10.9	11.0+
	6-12	Up to 10.0	10.0-11.4	11.5+
	13-16M	Up to 12.0	12.0-12.9	13.0+
	13-16F	Up to 10.0	10.0-11.4	11.5+
	16+M	Up to 12.0	12.0-13.9	14.0+
	16+F	Up to 10.0	10.0-11.9	12.0+
	Pregnant (after 6+ mos.)	Up to 9.5	9.5-10.9	11.0+
*Hematocrit (Packed cell volume in percent)	Up to 2	Up to 28	28-30	31+
	2-5	Up to 30	30-33	34+
	6-12	Up to 30	30-35	36+
	13-16M	Up to 37	37-39	40+
	13-16F	Up to 31	31-35	36+
	16+M	Up to 37	37-43	44+
	16+F	Up to 31	31-37	33+
	Pregnant	Up to 30	30-32	33+
*Serum Albumin (gm/100ml)	Up to 1	—	Up to 2.5	2.5+
	1-5	—	Up to 3.0	3.0+
	6-16	—	Up to 3.5	3.5+
	16+	Up to 2.8	2.8-3.4	3.5+
	Pregnant	Up to 3.0	3.0-3.4	3.5+
*Serum Protein (gm/100ml)	Up to 1	—	Up to 5.0	5.0+
	1-5	—	Up to 5.5	5.5+
	6-16	—	Up to 6.0	6.0+
	16+	Up to 6.0	6.0-6.4	6.5+
	Pregnant	Up to 5.5	5.5-5.9	6.0+
*Serum Ascorbic Acid (mg/100ml)	All ages	Up to 0.1	0.1-0.19	0.2+
*Plasma vitamin A (mcg/100 ml)	All ages	Up to 10	10-19	20+
*Plasma Carotene (mcg/100 ml)	All ages	Up to 20	20-39	40+
	Pregnant	—	40-79	80+
*Serum Iron (mcg/100 ml)	Up to 2	Up to 30	—	30+
	2-5	Up to 40	—	40+
	6-12	Up to 50	—	50+
	12+M	Up to 60	—	60+
	12+F	Up to 40	—	40+
*Transferrin Saturation (percent)	Up to 2	Up to 15.0	—	15.0+
	2-12	Up to 20.0	—	20.0+
	12+M	Up to 20.0	—	20.0+
	12+F	Up to 15.0	—	15.0+
**Serum Folacin (ng/ml)	All ages	Up to 2.0	2.1-5.9	6.0+
**Serum vitamin B_{12} (pg/ml)	All ages	Up to 100	—	100+

* Adapted from the Ten State Nutrition Survey
** Criteria may vary with different methodology.

Appendix G (cont'd)

Current Guidelines for Criteria of Nutritional Status for Laboratory Evaluation

Nutrient and Units	Age of Subject (years)	Criteria of Status		
		Deficient	Marginal	Acceptable
*Thiamine in Urine (mcg/g creatinine)	1-3	Up to 120	120-175	175+
	4-5	Up to 85	85-120	120+
	6-9	Up to 70	70-180	180+
	10-15	Up to 55	55-150	150+
	16+	Up to 27	27- 65	65+
	Pregnant	Up to 21	21- 49	50+
*Riboflavin in Urine (mcg/g creatinine)	1-3	Up to 150	150-499	500+
	4-5	Up to 100	100-299	300+
	6-9	Up to 85	85-269	270+
	10-16	Up to 70	70-199	200+
	16+	Up to 27	27- 79	80+
	Pregnant	Up to 30	30- 89	90+
**RBC Transketolase-TPP-effect (ratio)	All ages	25+	15- 25	Up to 15
**RBC Glutathione Reductase-FAD-effect (ratio)	All ages	1.2+	—	Up to 1.2
**Tryptophan Load (mg Xanthurenic acid excreted)	Adults (Dose: 100mg/kg body weight)	25+(6 hrs.)	—	Up to 25
		75+(24 hrs.)	—	Up to 75
**Urinary Pyridoxine (mcg/g creatinine)	1-3	Up to 90	—	90+
	4-6	Up to 80	—	80+
	7-9	Up to 60	—	60+
	10-12	Up to 40	—	40+
	13-15	Up to 30	—	30+
	16+	Up to 20	—	20+
*Urinary N'methyl nicotinamide (mg/g creatinine)	All ages	Up to 0.2	0.2-5.59	0.6+
	Pregnant	Up to 0.8	0.8-2.49	2.5+
**Urinary Pantothenic Acid (mcg)	All ages	Up to 200	—	200+
**Plasma vitamin E (mg/100ml)	All ages	Up to 0.2	0.2-0.6	0.6+
**Transaminase Index (ratio)				
†EGOT	Adult	2.0 +	—	Up to 2.0
‡EGPT	Adult	1.25+	—	Up to 1.25

* Adapted from the Ten State Nutrition Survey
** Criteria may vary with different methodology
† Erythrocyte Glutamic Oxaloacetic Transaminase
‡ Erythrocyte Glutamic Pyruvic Transaminase

From Christakis, G. (Ed.): Nutritional Assessment in Health Programs. *American Journal of Public Health* (Suppl) 63:34-35, 1973. Used with permission of the publisher.

Composition of Oral and Enteral Supplements

Product	Composition (Source) Carbohydrate (g/100 kcal)	Protein (g/100 kcal)	Fat (g/100 kcal)	Caloric Density	Lactose	Residue	Notes
Citrotein[a]	18.42 (Maltodextrins, sucrose, glucose)	6.05 (Egg albumin)	0.26 (Soy oil, monoglycerides, diglycerides)	0.66 kcal/ml	No	Low	Protein and vitamin supplement to clear liquid diet
Delmark Eggnog[b]	13 (Nonfat dry milk, maltodextrin, sugar)	5.25 (Nonfat dry milk, egg white, egg yolk solids)	3.0 (Cottonseed oil, soy oil, egg yolk)	1.16 kcal/ml	Yes		
Delmark Milkshake[b]	12.5 (Sugar, maltodextrins, ice cream mix)	3.8 (Egg, milk)	3.85 (Vegetable oil)	0.95 kcal/ml	Yes		
Dietene[a]	15.75 (Nonfat milk, sucrose)	8.75 (Nonfat milk)	0.2	0.8 kcal/ml	Yes		Add powder to milk
dp High p.e.r. Protein	2.0	20.6	1.0	2.58 kcal/g			Protein supplement; low electrolyte
Gevral[d]	6.68 (Lactose, sucrose)	17.1 (Calcium caseinate)	0.57 (Milk fat)	0.653 kcal/ml	Yes	Low	Protein-calorie supplement; artificial flavors
Lolactene[a]	13 (Corn syrup solids, sucrose)	6.6 (Caseinate)	2.3 (Vegetable oil, monoglycerides, diglycerides)	0.8 kcal/ml	Low	None	
Lonalac[e]	30 (Lactose)	21 (Casein)	49 (Coconut oil)	0.67 kcal/ml	High	Low	Low sodium, high potassium

Note: The composition of these products is subject to change. Current product literature should be consulted before use. This table is not intended to be comprehensive.
[a] Doyle Pharmaceutical.
[b] Delmark.
[c] General Mills.
[d] Lederle Laboratories.
[e] Mead Johnson Nutritional.

Product (Form)	Composition (Source) Carbohydrate (g/100 kcal)	Protein (g/100 kcal)	Fat (g/100 kcal)	Caloric Density	Osmolality (mOsm/kg)	Lactose	Residue	Notes
Protein sources								
Casec[a] (powder)	0	23.78 (Calcium caseinate)	0.54 (Butterfat	3.7kcal/g		No	Low	Add to liquid or food; provides no vitamins
Promix[b] (powder)	2.27	22.7 (Whey protein)	1.1	3.52 kcal/g		No		Add to liquid foods; provides no vitamins
Propac[c] (powder)	1.25	19.2 (Whey protein)	4.5	4.0 kcal/g		Yes		Add to liquid foods; provides no vitamins
Carbohydrate sources								
Cal-Power[d] (liquid)	27.2 (Deionized corn syrup)	0.06	0	1.8 kcal/ml		No		Low electrolyte; high osmolality; for oral or tube feedings
Controlyte[e] (powder)	14.3 (Cornstarch hydrolysate)	Trace	4.8 (Soy oil)	2.0 kcal/ml (or 5.0 kcal/g)	598	No	Low	For oral or tube feedings; calorie source; add to liquid or food; high osmolality; low protein; low electrolyte
Hy-Cal[f] (liquid)	24.41 (Liquid glucose)	0.01	0.01	2.5 kcal/ml	2,781	No	Low	Oral supplement; low electrolyte; high osmolality
Lytren[g] (powder)	25.3	0	0	0.333 kcal/g	290	No	Low	Electrolyte source; provides some kilocalories; useful in prevention of metabolic defects due to diarrhea
Moducal[h] (liquid or powder)	25 (Maltodextrins)	0	0	2.0 kcal/ml (liq.) 4.0 kcal/g (powd.)	725 (liq.)	No	Low	Calorie source

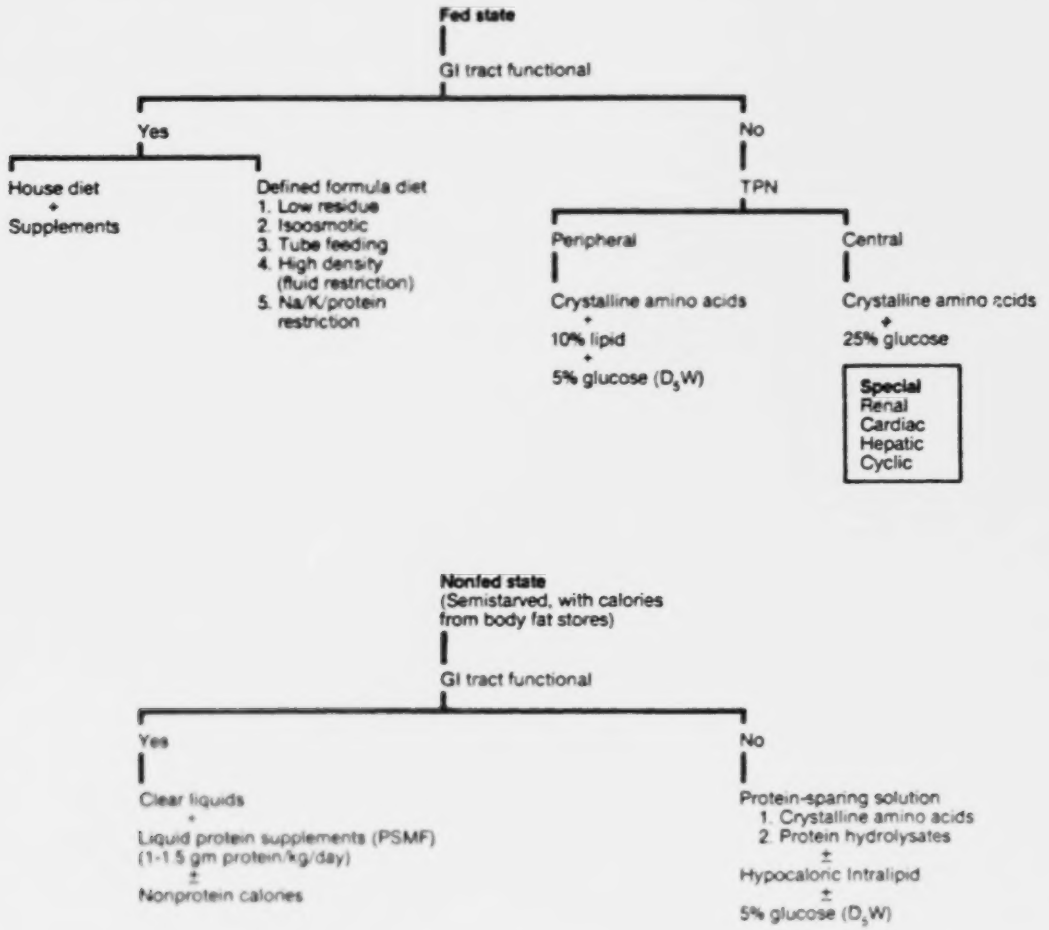
Product (Form)	Composition (Source)			Caloric Density	Osmolality (mOsm / kg)	Lactose	Residue	Notes
	Carbohydrate (g/100 kcal)	Protein (g/100 kcal)	Fat (g/100 kcal)					
Pedialyte[a]	25	0	0	0.2 kcal/ml				Calorie and electrolyte source
Polycose[a] (liquid or powder)	25	0	0	2.0 kcal/ml 4.0 kcal/g	570	No	Low	Caloric supplement; low electrolyte
Sumacal[b] (powder)	25 (Maltodextrins)	0	0	4.0 kcal/g	680 (Cherry, lemon, lime)	No	Low	Caloric supplement; low electrolyte
Sumacal Plus[c] (powder)	3.2	0	0	2.5 kcal/g	890		Low	Caloric supplement; low electrolyte
Lipid sources								
Lipomul-Oral[b]	0.11	0.01	11.11 (Corn oil)	6.0 kcal/ml		No	Low	Oral supplement; low electrolyte
MCT Oil[b]	0	0	12.05 (Coconut oil fraction)	7.7 kcal/ml	Negligible	No		Oral supplement; 60% C8 and 24% C10 fatty acids; low electrolyte
Microlipid[c]	0	0	11.11 (Soy, corn, or safflower oil)	4.5 kcal/ml	80	No	Low	Oral supplement; low electrolyte

Note: The composition of these products changes frequently. Current product literature should be consulted before use. This table is not intended to be comprehensive.
[a] Mead Johnson Nutritional.
[b] Navaco Laboratories.
[c] Organon Pharmaceuticals.
[d] General Mills.
[e] Doyle Pharmaceutical.
[f] Beecham Laboratories.
[g] Ross Laboratories.
[h] The Upjohn Company.

From Zeman, F.J.: *Clinical Nutrition and Dietetics*. Lexington, Massachusetts: Collamore Press, 1983. Used with permission of the publisher.

Appendix I

Logic Tree Depicting Use of Feeding Modules in Nutritional Support



From Blackburn G.L. and Harvey, K.B.: Nutritional Assessment. *Postgraduate Medicine*, 11 (5):46-63. Used with permission of the publisher.

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Some Abbreviations Used in the Nutrition in Primary Care Series

ATP	adenosine triphosphate
c	cup
cc	cubic centimeter
CNS	central nervous system
FDA	Food and Drug Administration
gm	gram
IBW	ideal body weight
IU	International Units
kcal	kilocalorie
kg	kilogram
lb	pound
lg	large
MCV	mean corpuscular volume
MDR	minimum daily requirement
med	medium
μg	microgram
mEq	milliequivalent
mg	milligram
MJ	megajoule
ml	milliliter
oz	ounce
RDA	Recommended Dietary Allowances
RE	retinol equivalents
sl	slice
sm	small
Tbsp	Tablespoon
TPN	total parenteral nutrition
tsp	teaspoon
USDA	United States Department of Agriculture